

Figure 1. Sensor Placement Relative To Bit

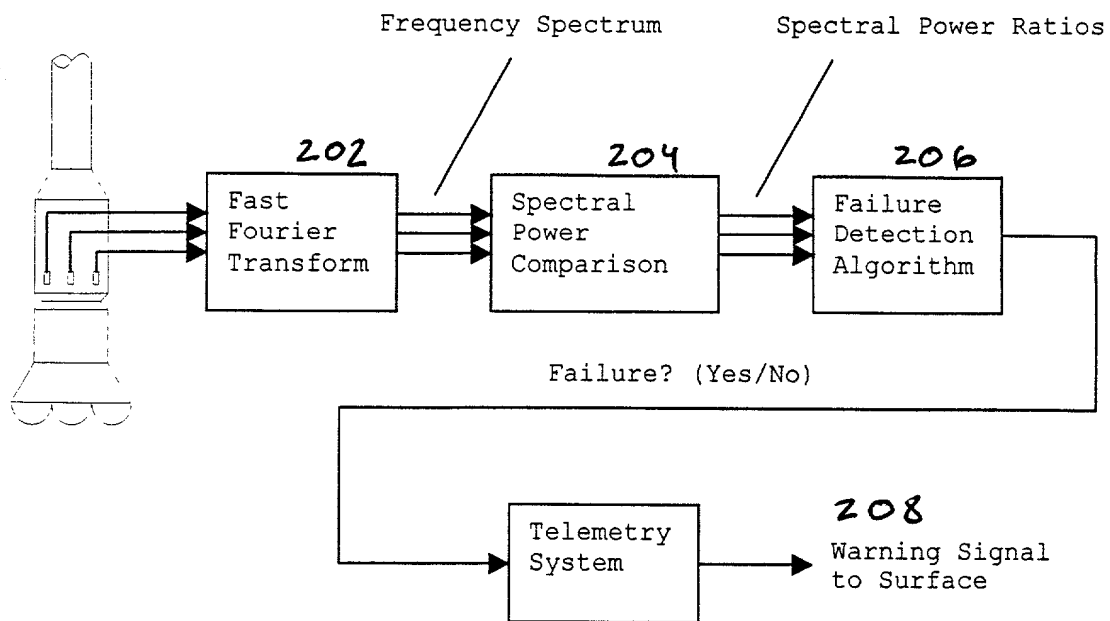


Figure 2

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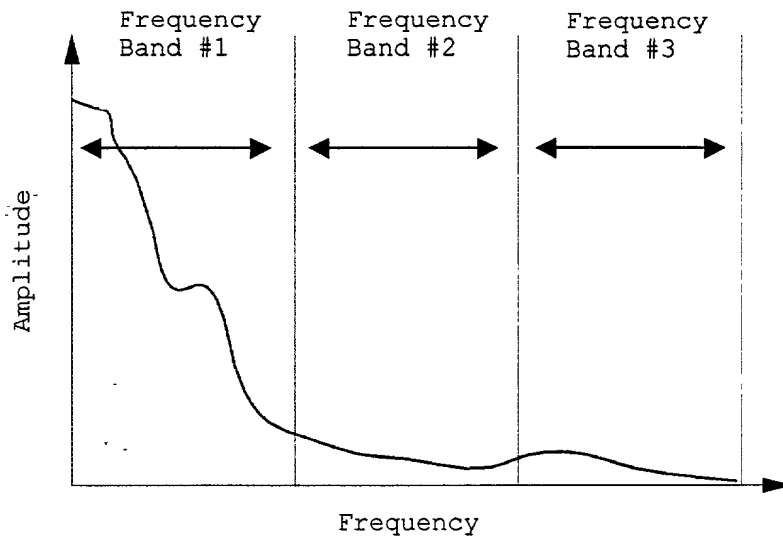


Figure 3. Frequency Band Arrangement

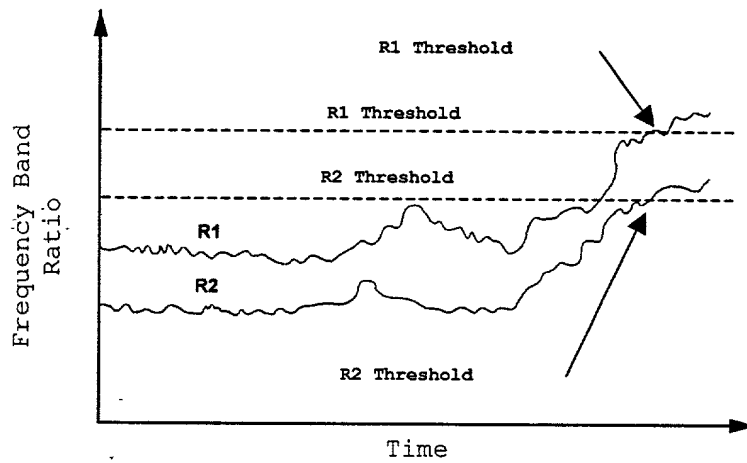


Figure 4. Threshold Failure Detection

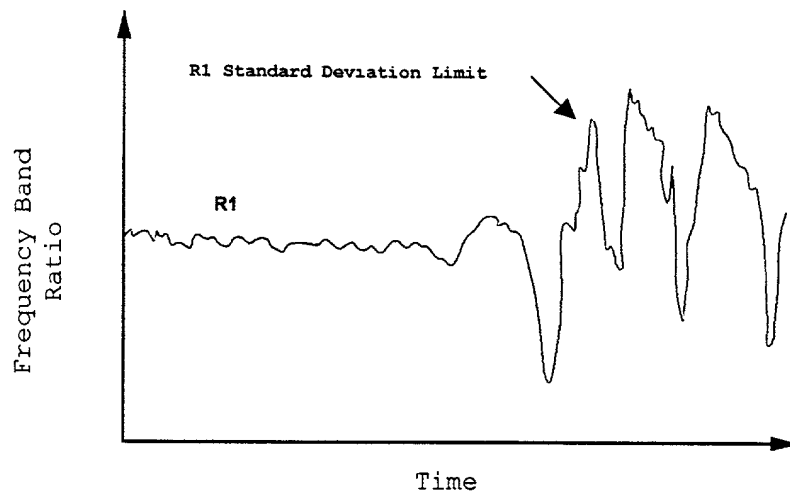


Figure 5 Statistical Failure Detection

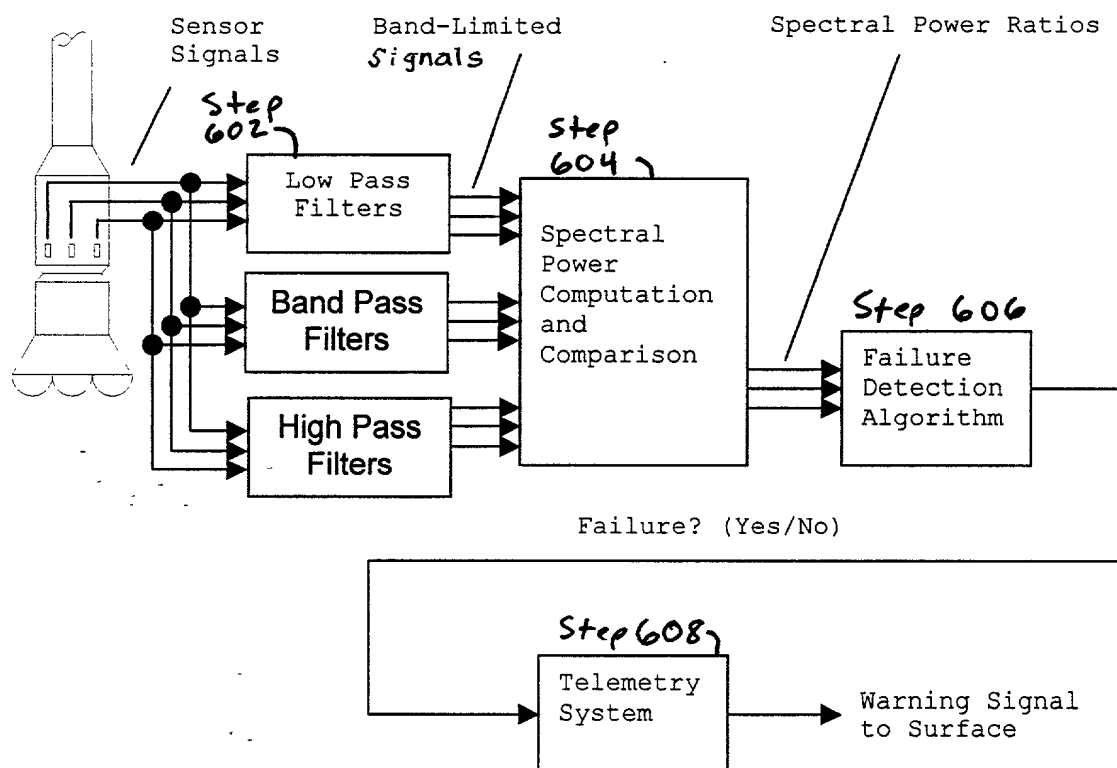


Figure 6 SPRA Method Using Analog Filters Spectral Power Separation

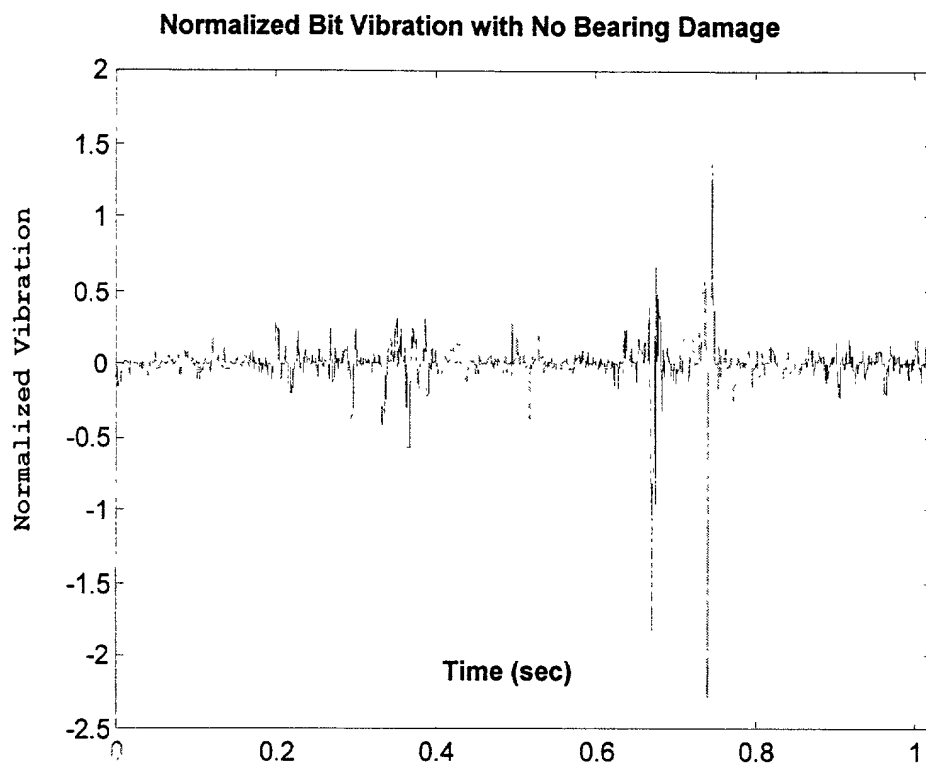


Figure 7.

Discrete FFT of Vibration Data with No Bearing Damage

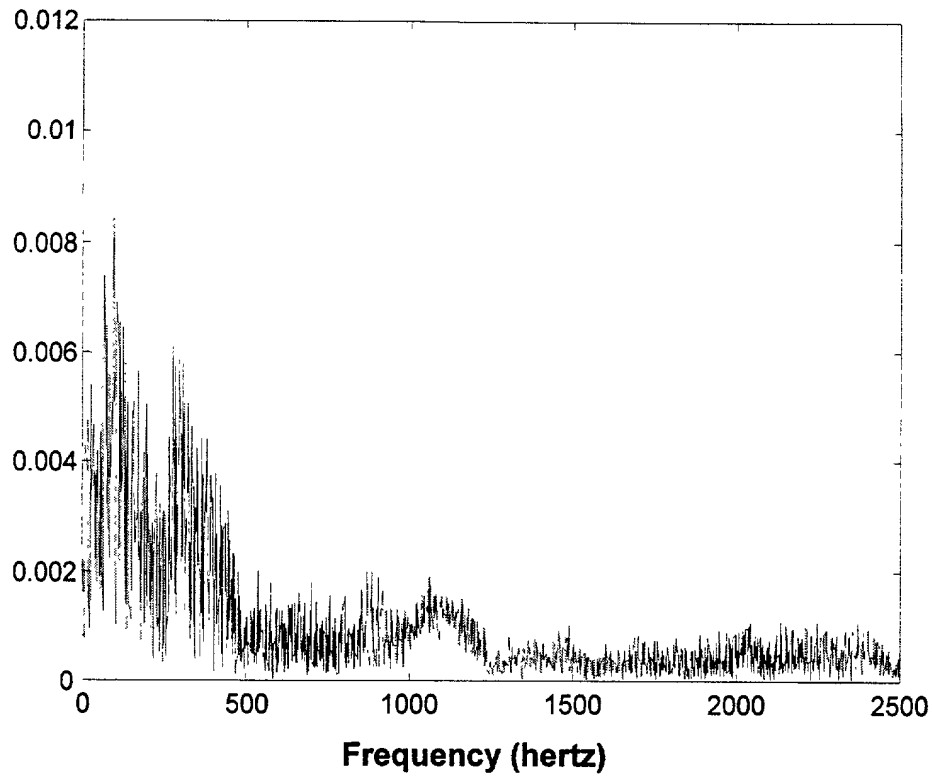


Figure 8.

Spectral Power Analysis Bearing with No Damage

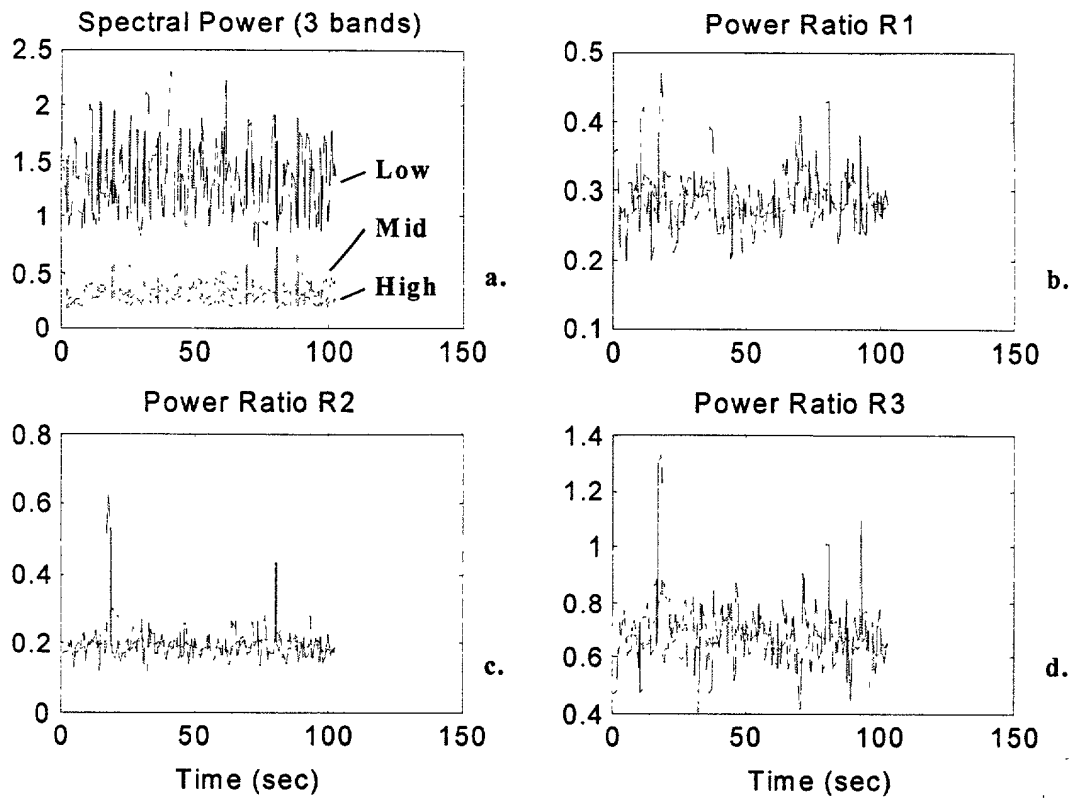


Figure 9.

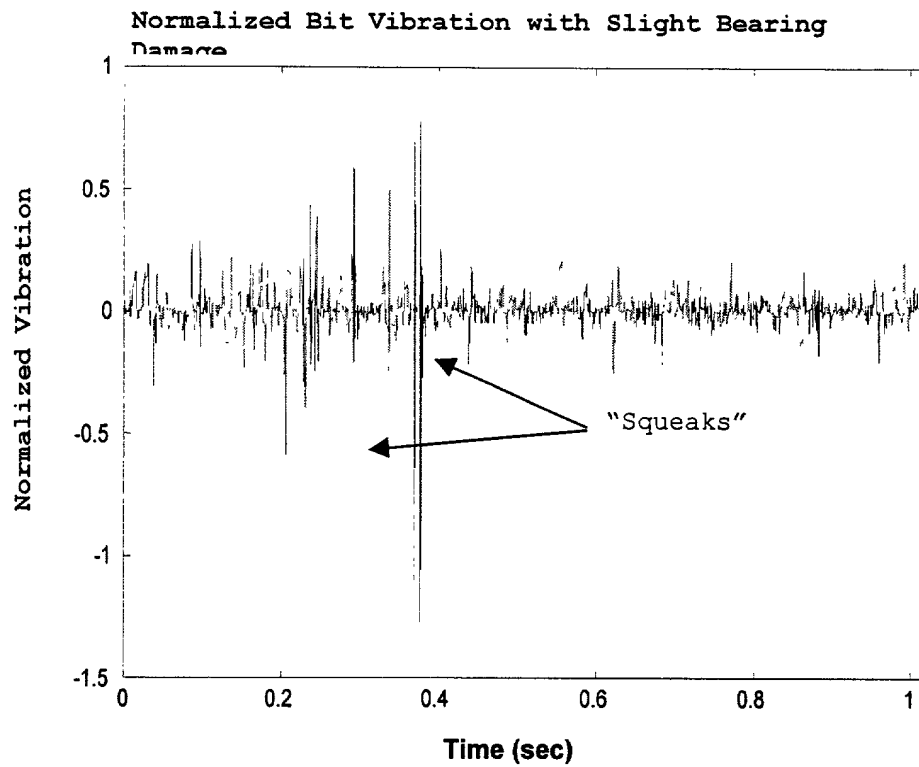


Figure 10.

Discrete FFT of Vibration Data with Initial Bearing Damage

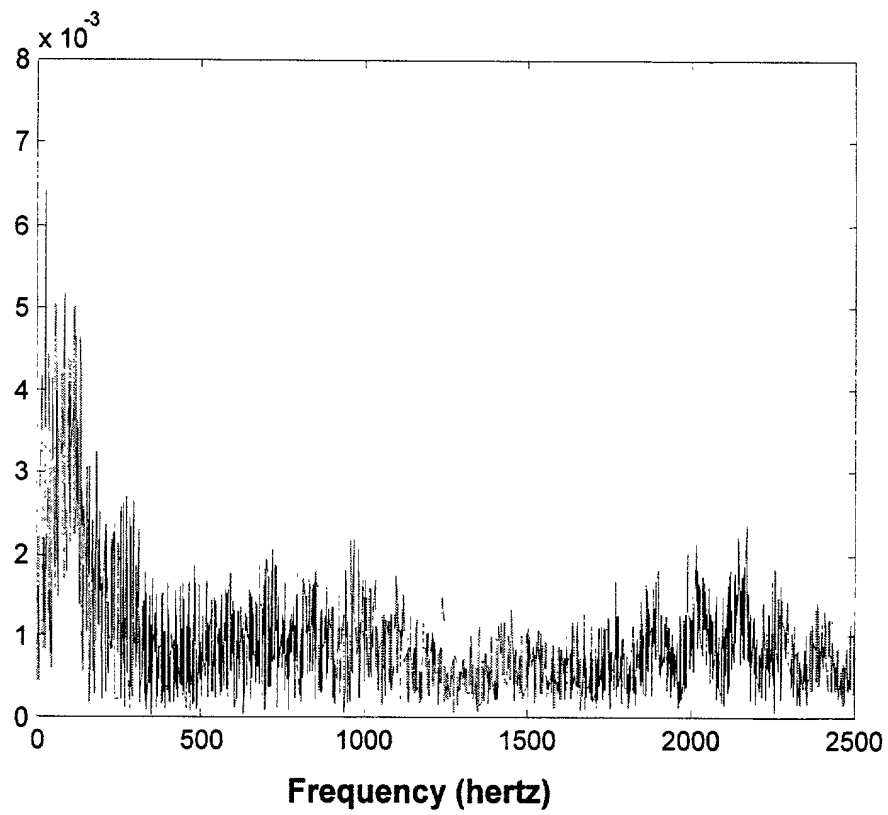


Figure 11.

Spectral Power Analysis for Slightly Damaged Bearing

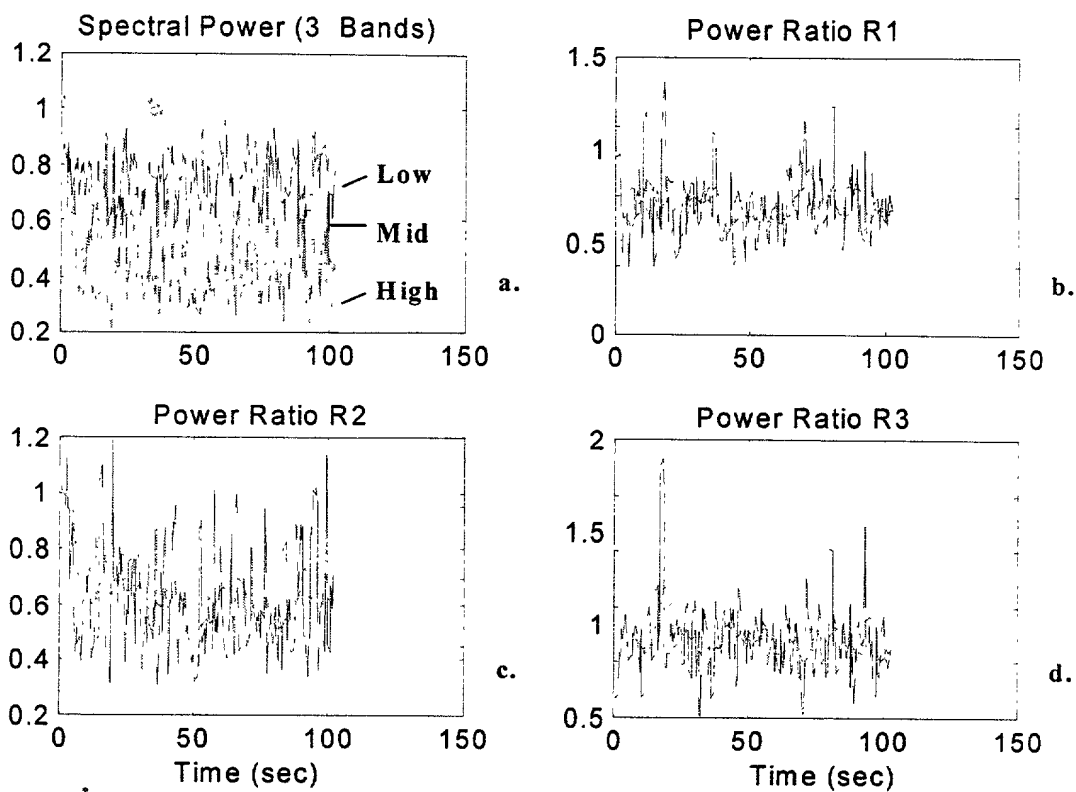


Figure 12.

Normalized Bit Vibration with Moderate Bearing Damage

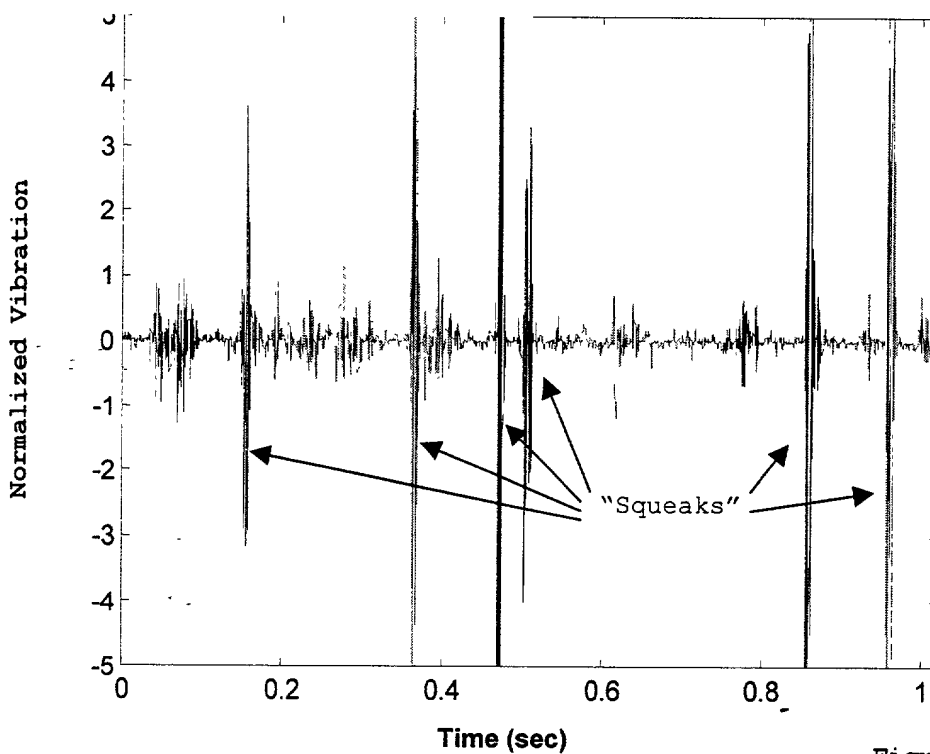


Figure 13.

Discrete FFT of Vibration Data for Moderate Bearing Damage

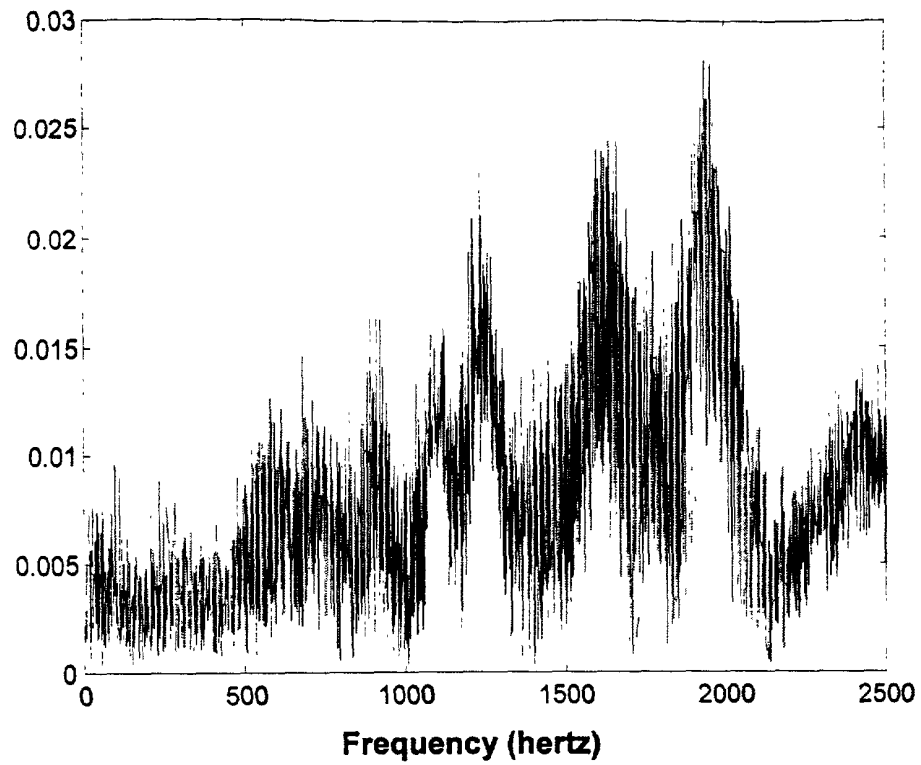


Figure 14.

10035950 101601

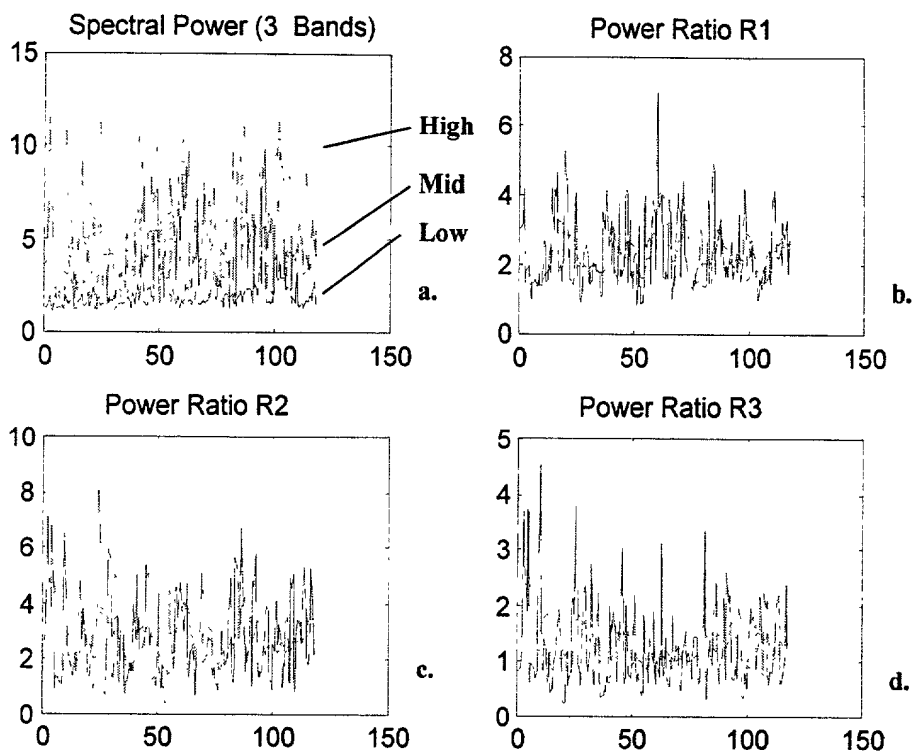


Figure 15.

10035350 100001

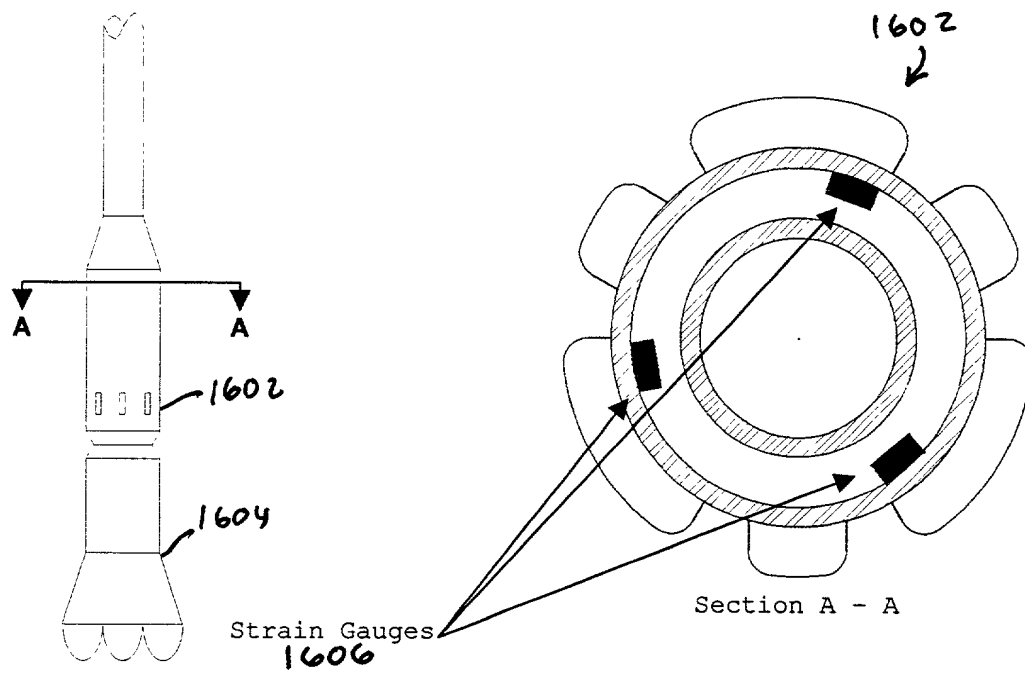


Figure 16. Strain Gauge Placement In Sensor Housing

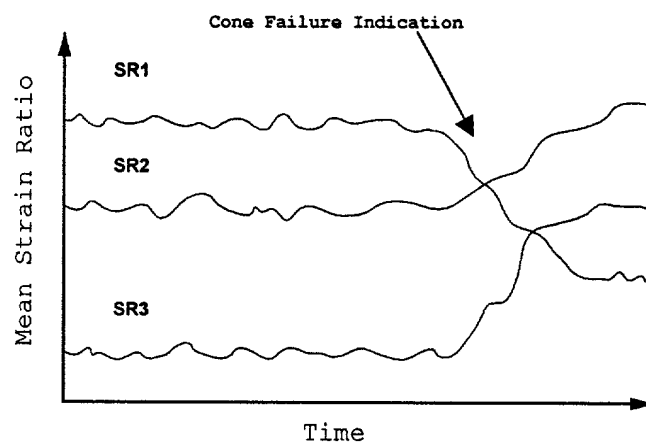


Figure 17. Failure Indication (MSRA Method)

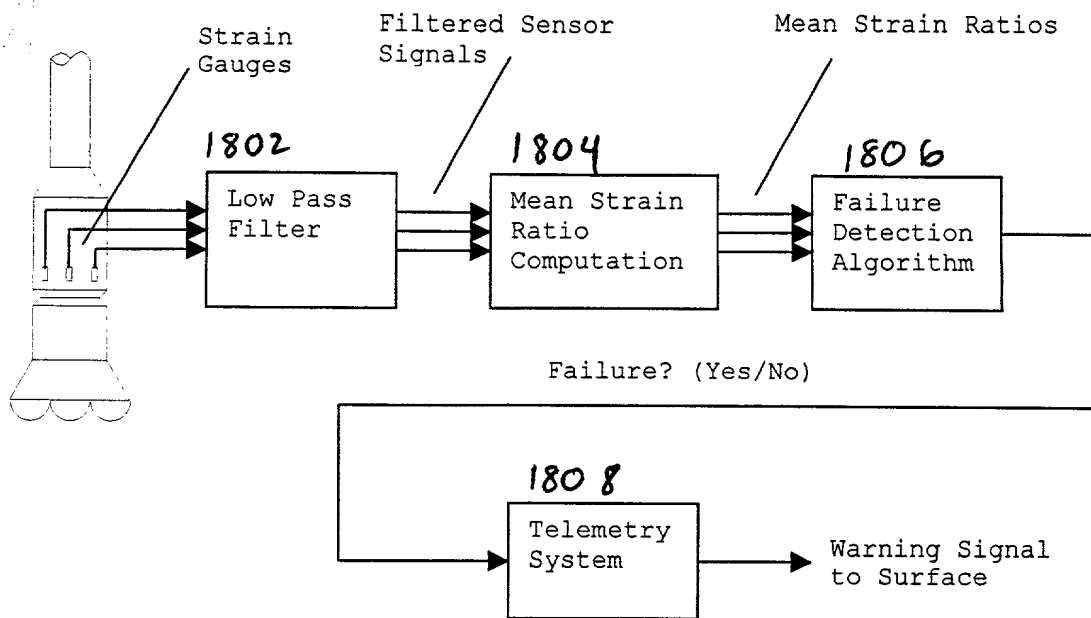


Figure 18. Schematic of MSRA Failure Detection Scheme

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Strain Gauge for No Bearing Damage

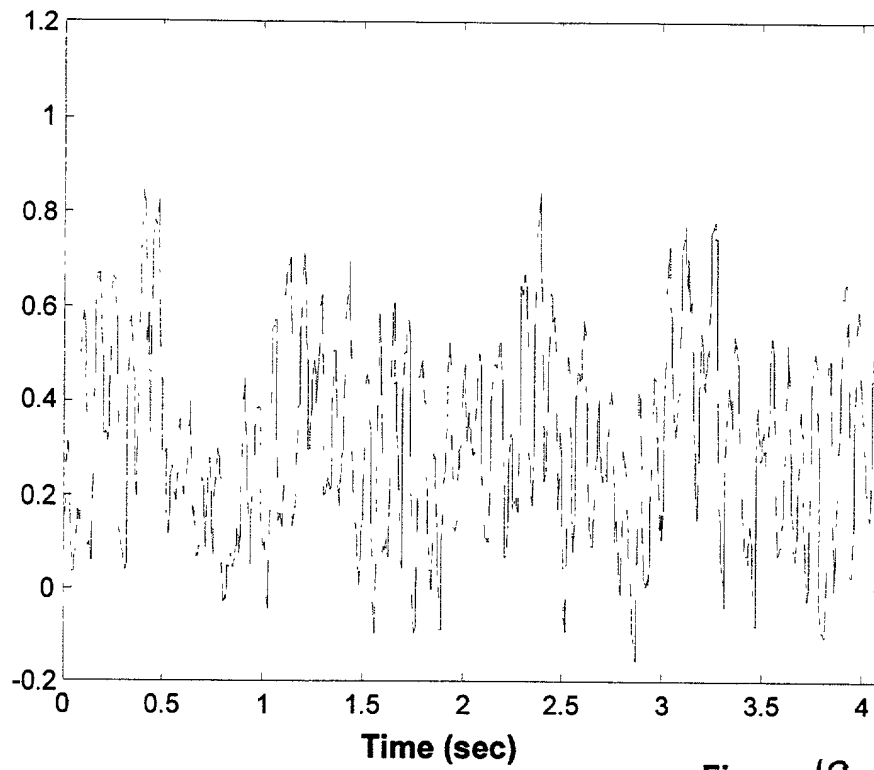


Figure 19

Discrete FFT of Strain Gauge Signal for No Bearing Damage

T.09207.0655004

Discrete FFT of Strain Gauge Signal for No Bearing Damage

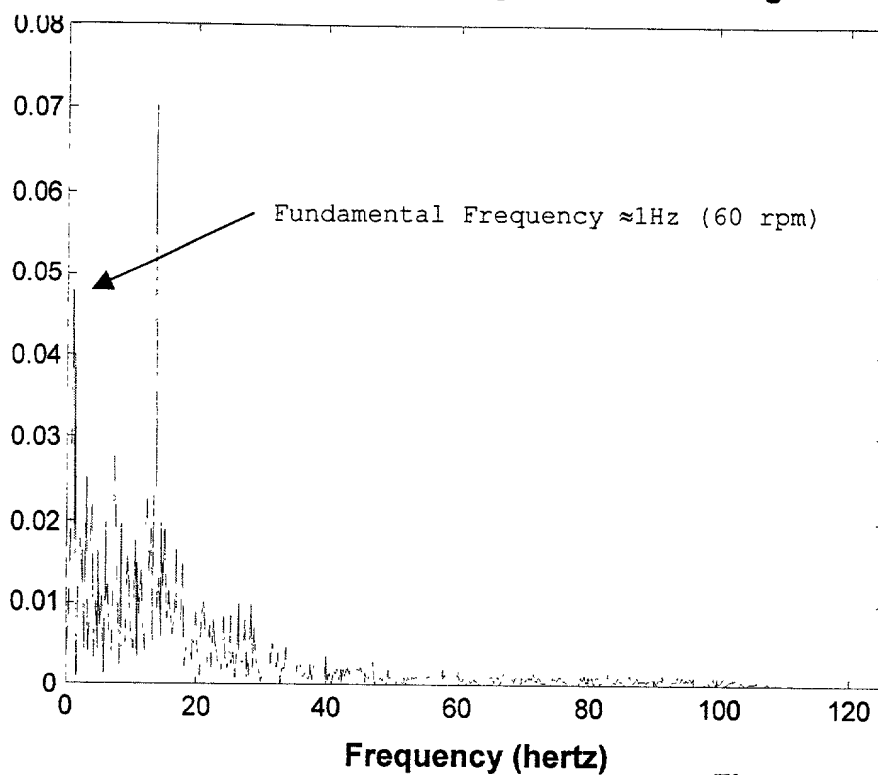


Figure 20.

100660 103604
106204 095004

Mean Strain Analysis for Bearing with No Damage

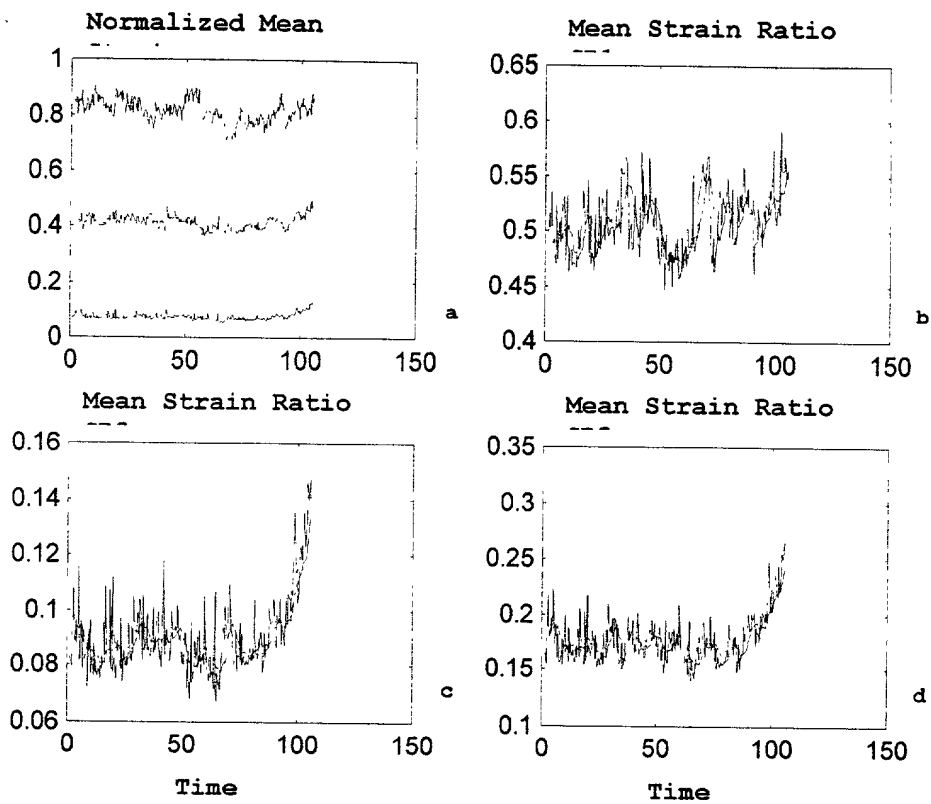


Figure 21.

Strain Gauge Signal when Bearing Lightly Damaged

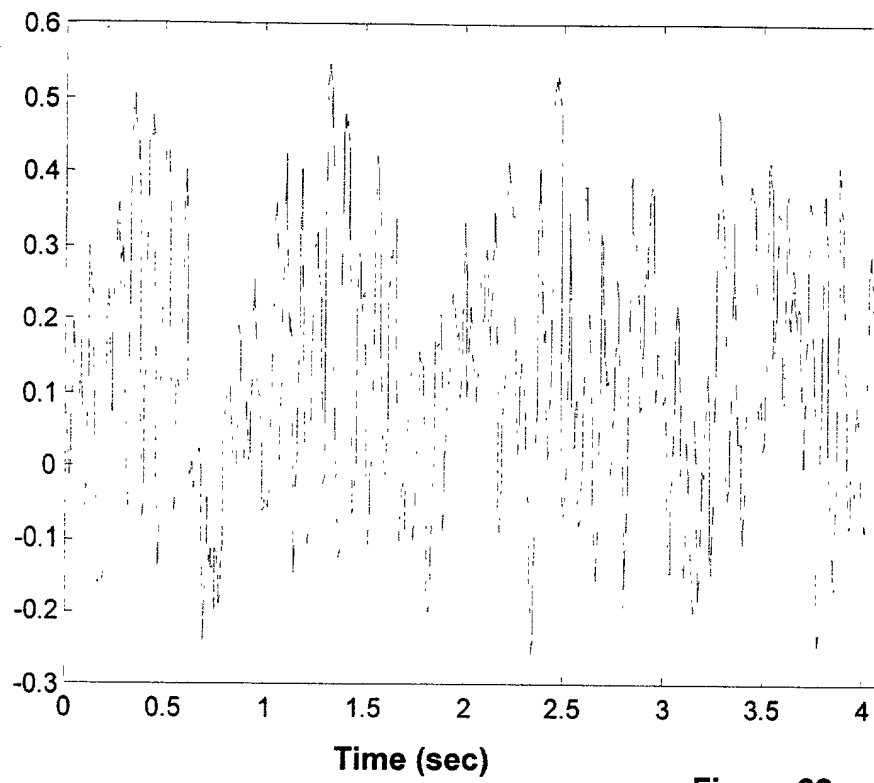


Figure 22.

100330 103604
T0900T 090500T

Discrete FFT of Strain Gauge Signal for Light Bearing Damage

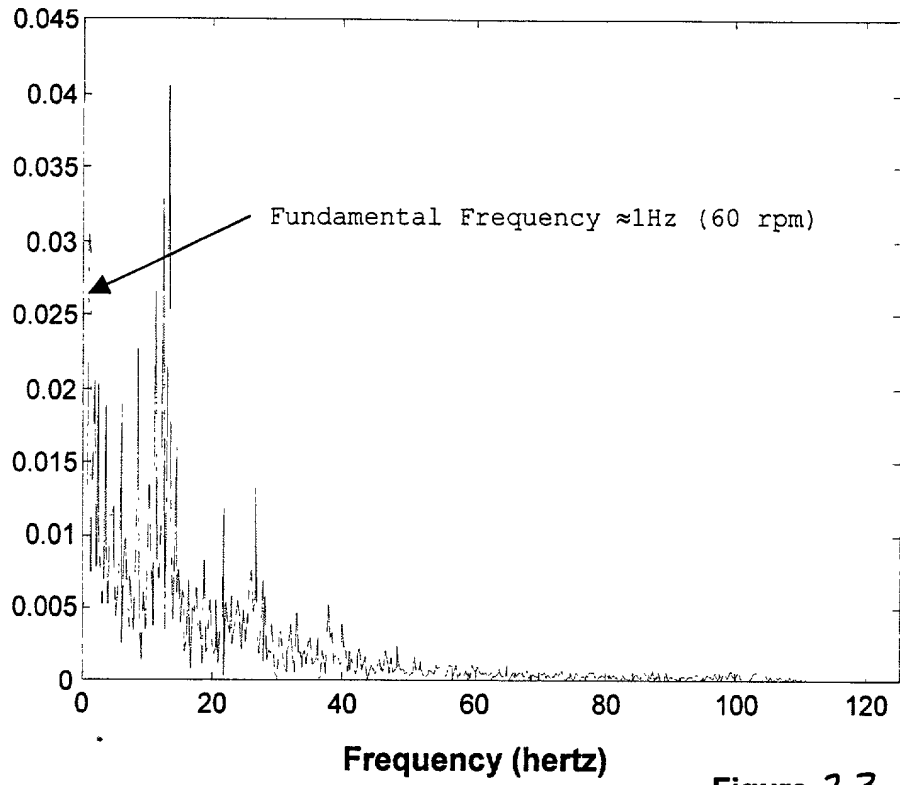


Figure 23

400530 103604
T090T 0900T

Mean Strain Analysis for Bearing with Light Damage

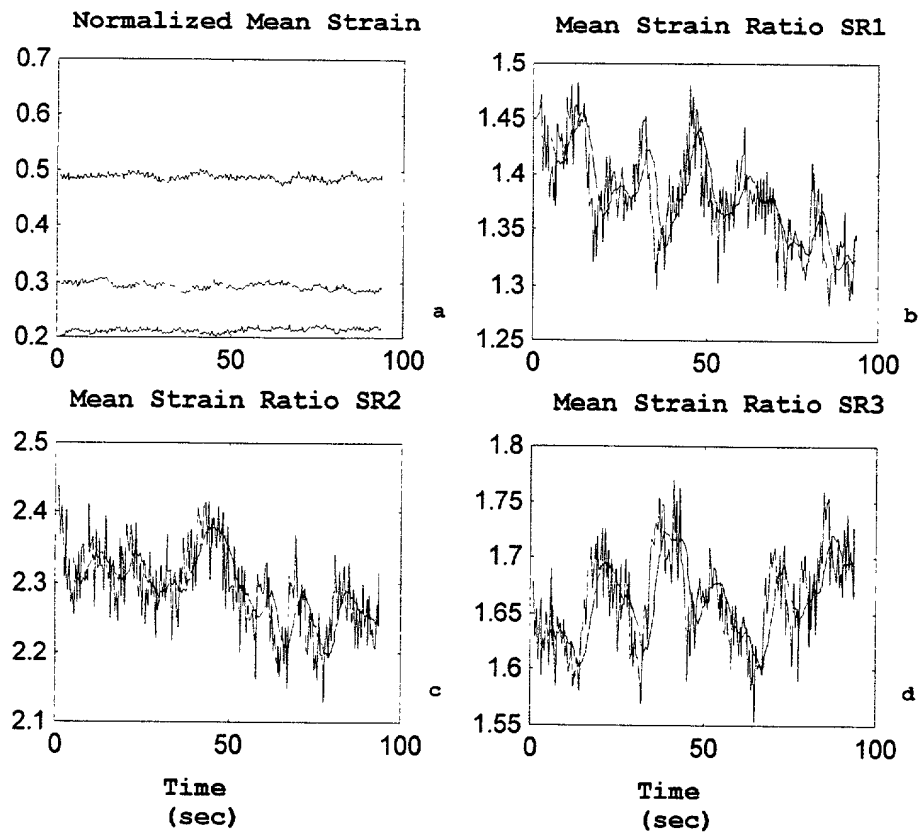


Figure 24

1005360 10601
1005360 10601

Strain Gauge Signal when Bearing Moderately Damaged

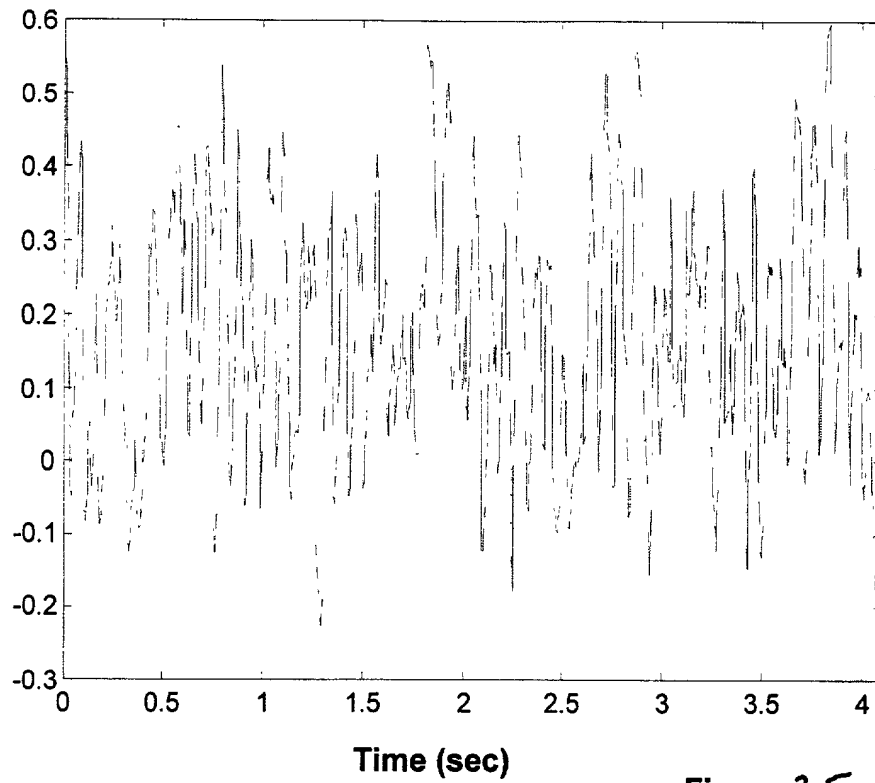


Figure 25

Discrete FFT of Strain Gauge Signal for Moderate Bearing Damage

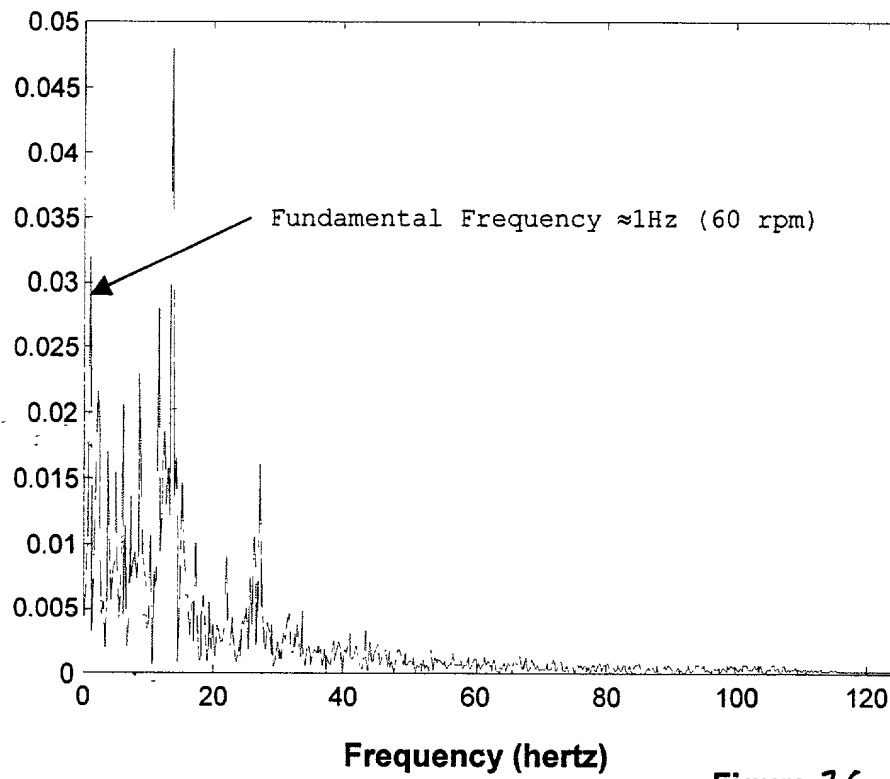


Figure 26

Mean Strain Analysis for Bearing with Moderate Damage

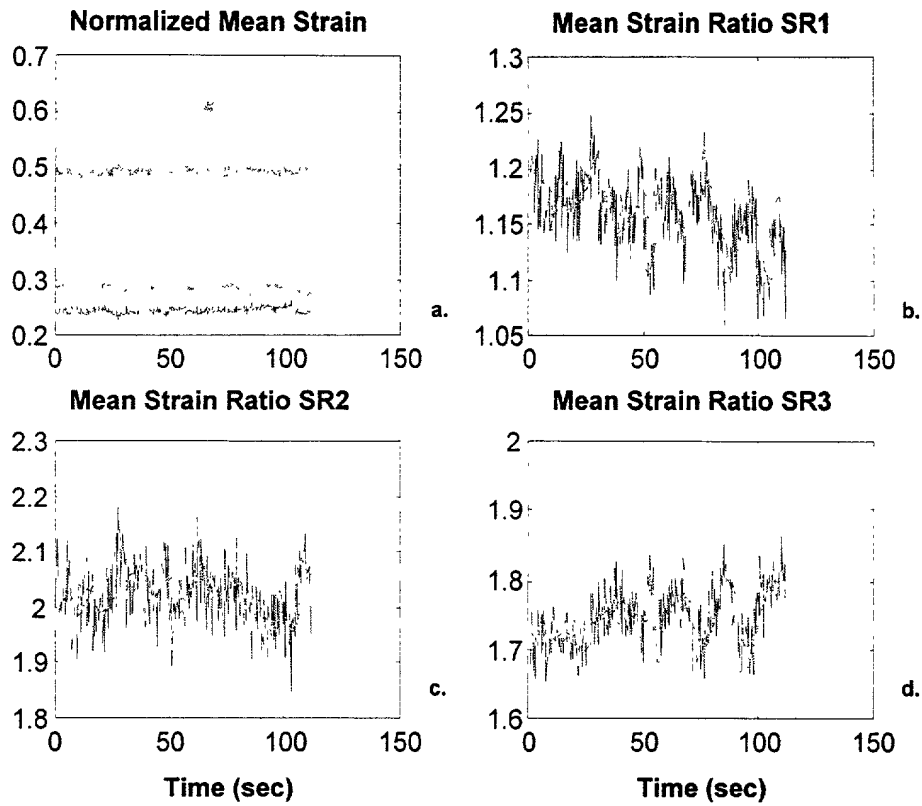


Figure 2.7

Strain Gauge Signal with Bearing In Early Failure

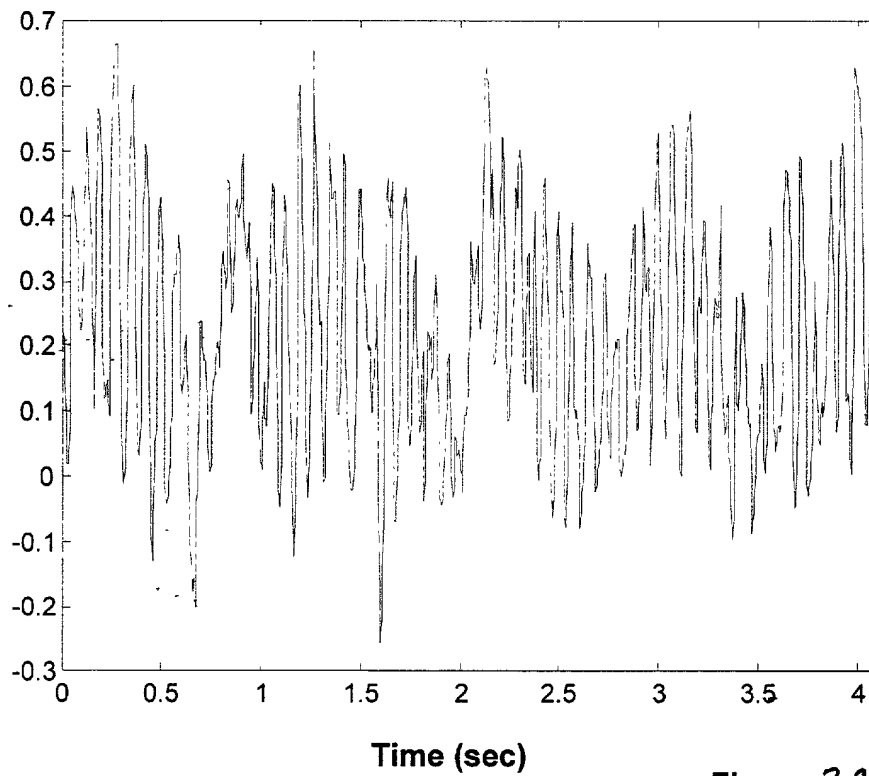


Figure 2.8

Discrete FFT of Strain Gauge Signal for Bearing In Early Failure

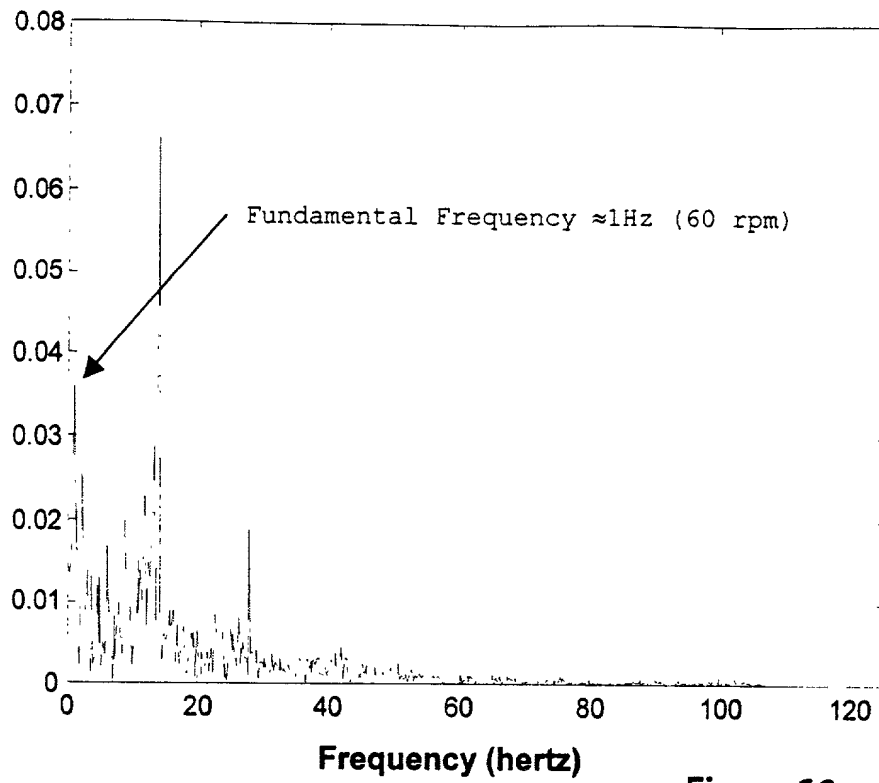


Figure 29

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Mean Strain Analysis for Bearing in Early Failure

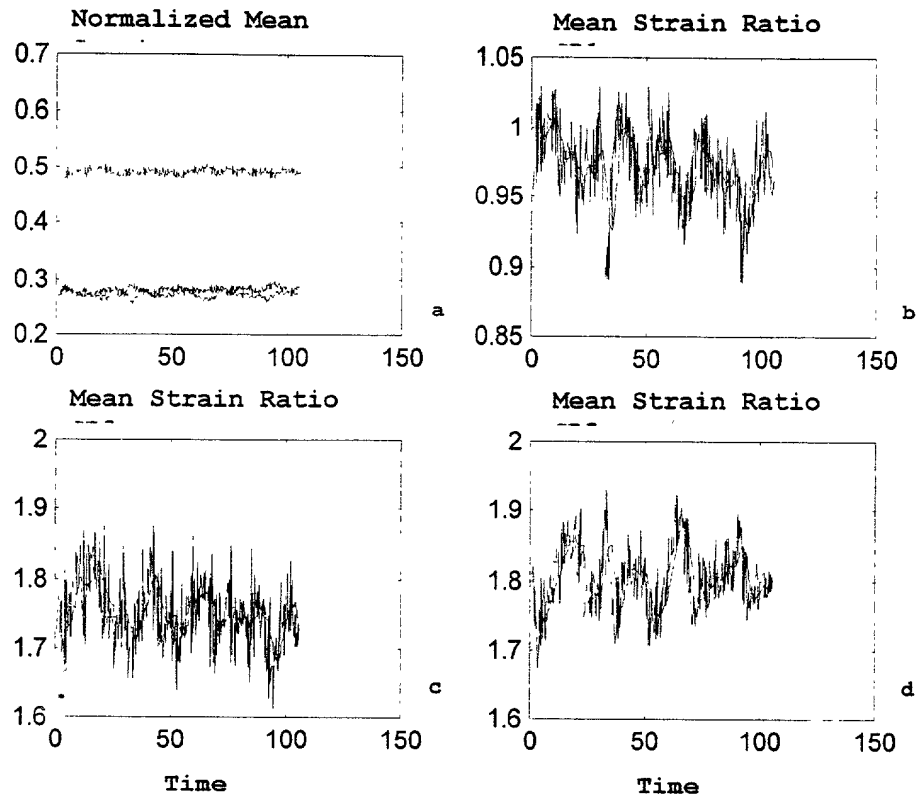


Figure 30.

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103204 0555004

Mean Strain Analysis for Shifting Load Condition

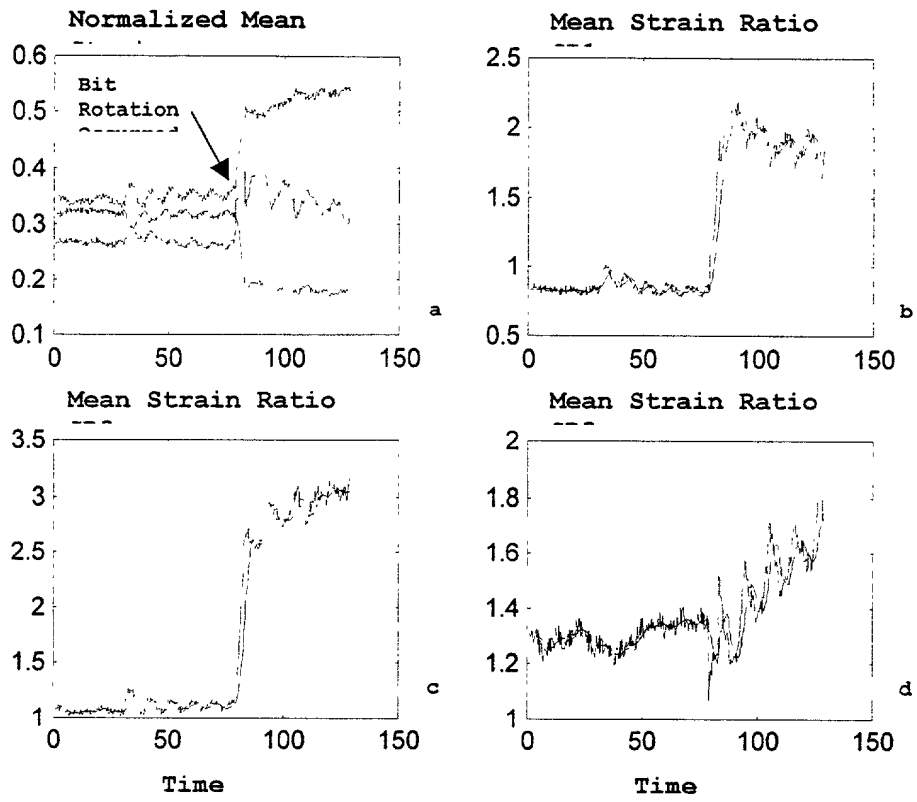


Figure 31.

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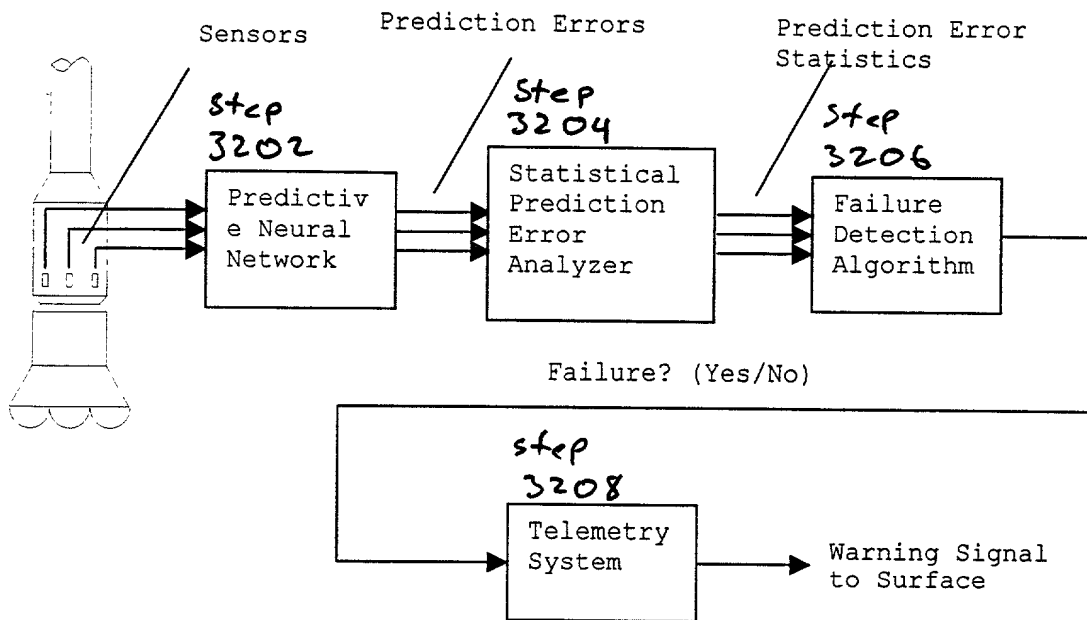


Figure 32 Schematic of ANNPA Bearing Failure Detection Scheme

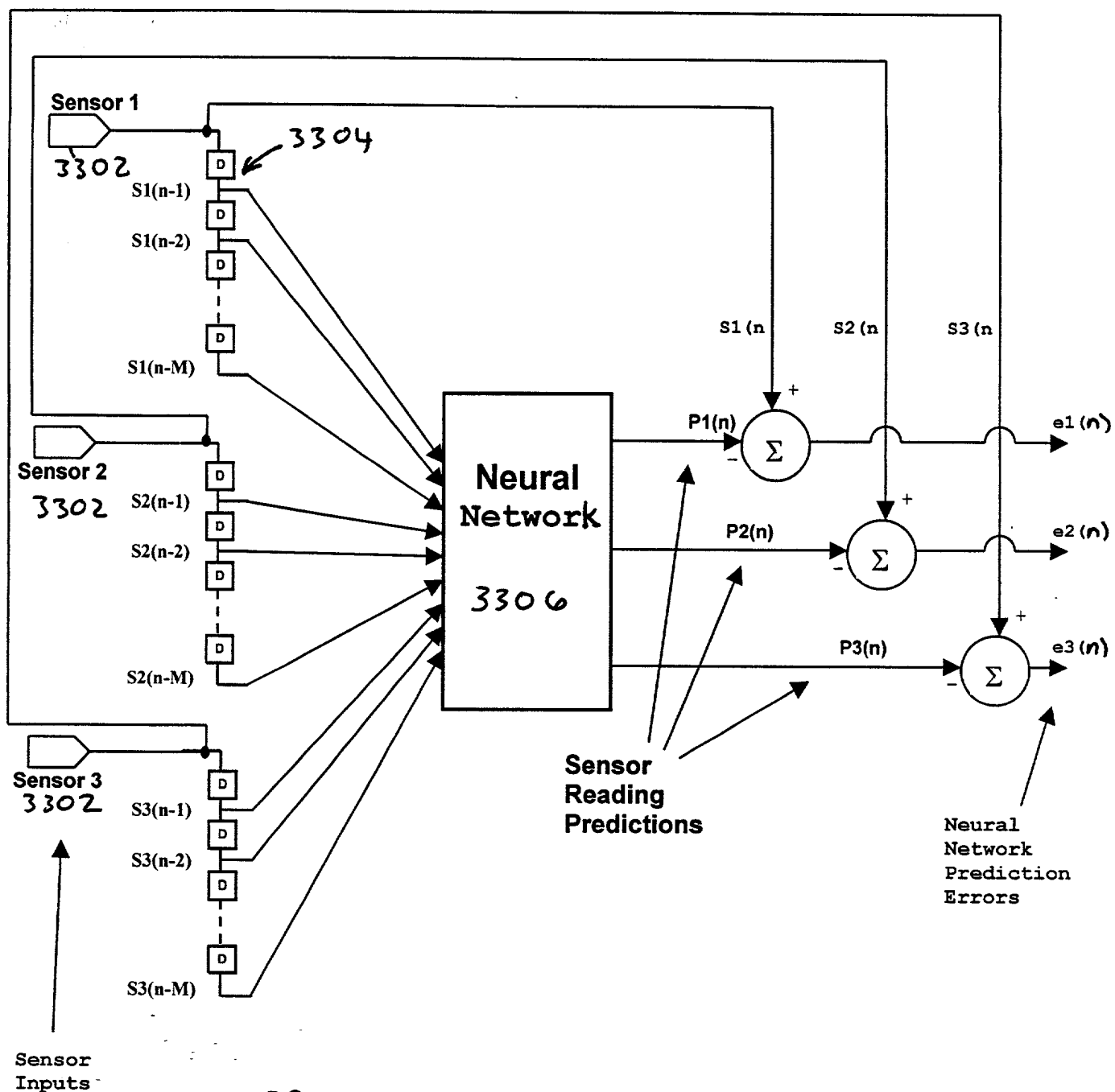


Figure 33 Adaptive Neural Network Predictor (ANNPA Method)

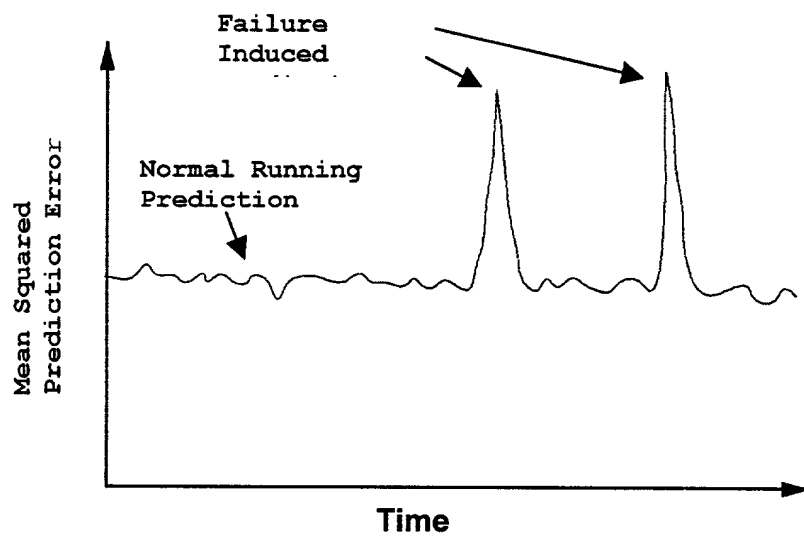


Figure 34 Failure Indications (ANNPA Method)

Acceleration (No Bearing Damage)

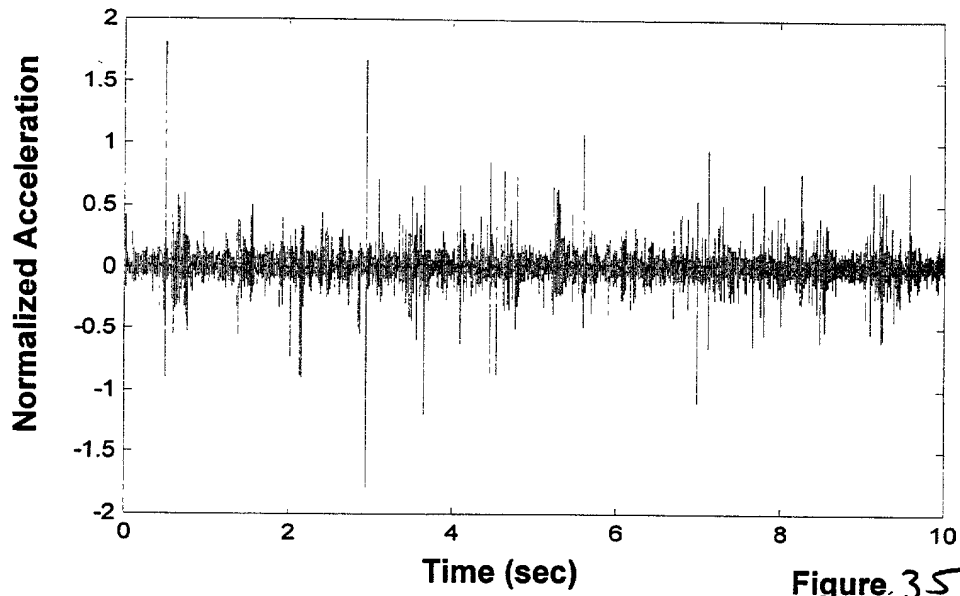


Figure 35

Acceleration Prediction Error (No Bearing Damage)

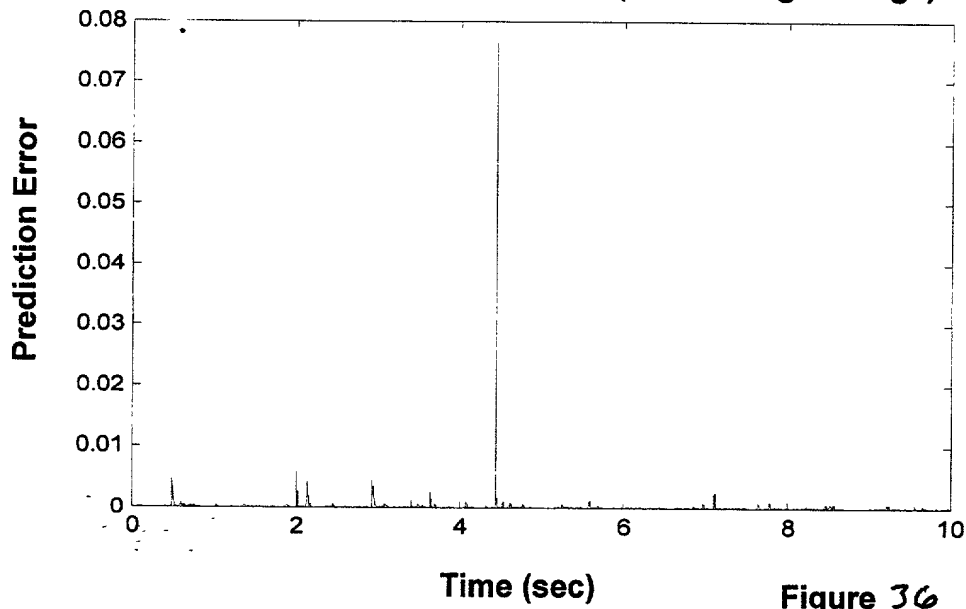


Figure 36

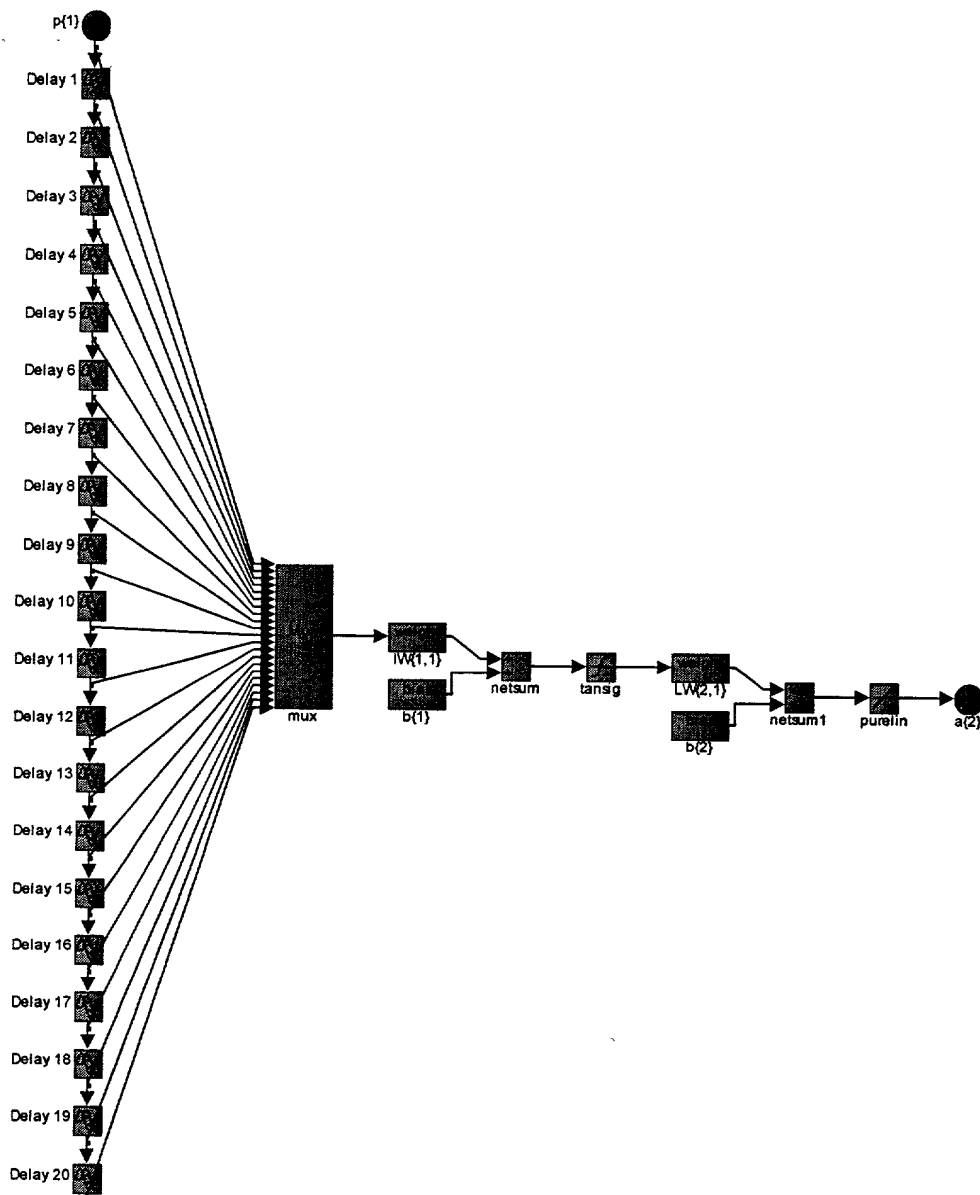
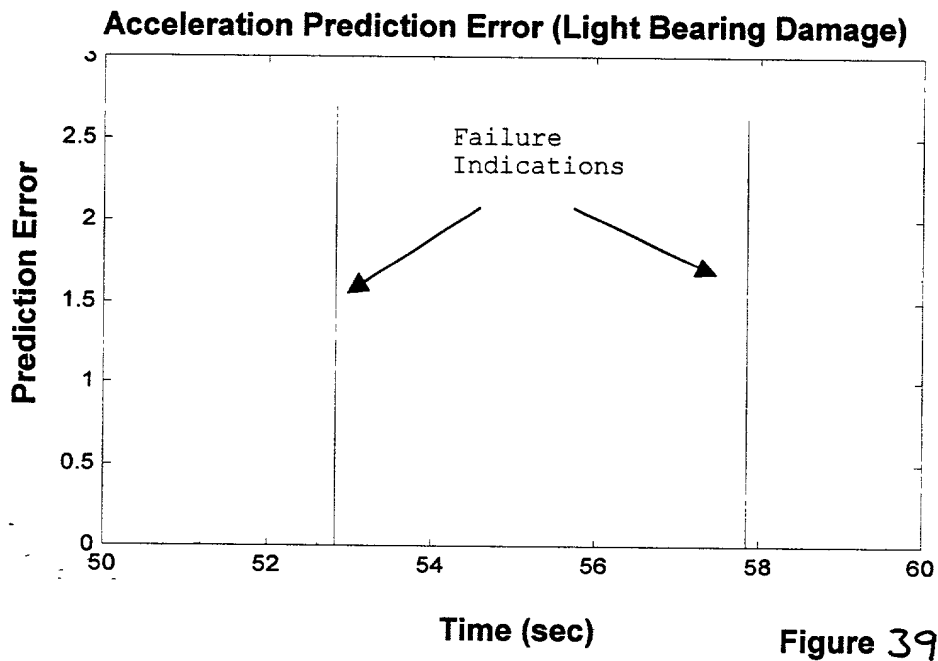
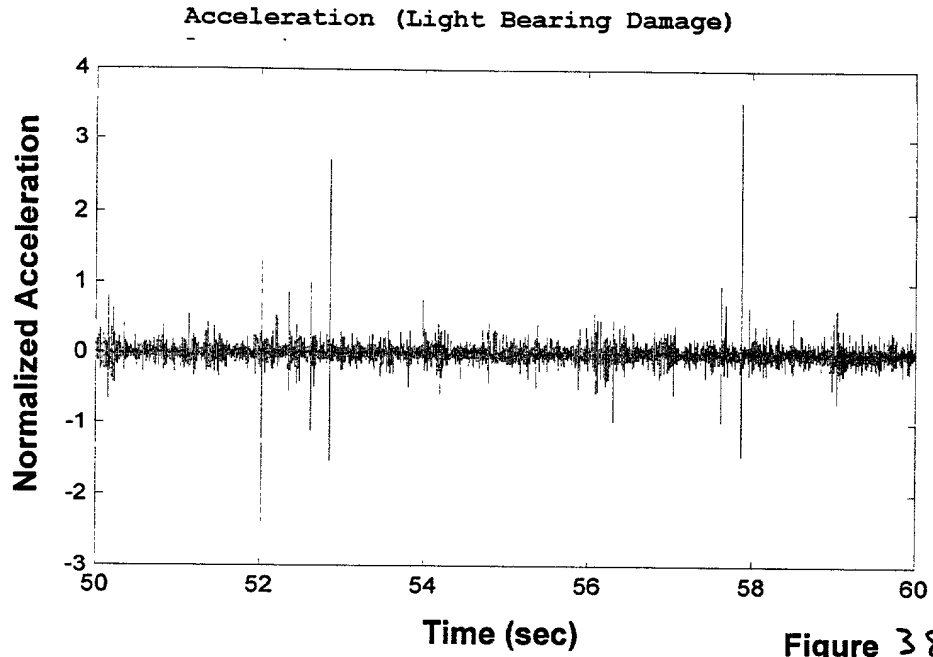


Figure 37



Acceleration (Moderate Bearing Damage)

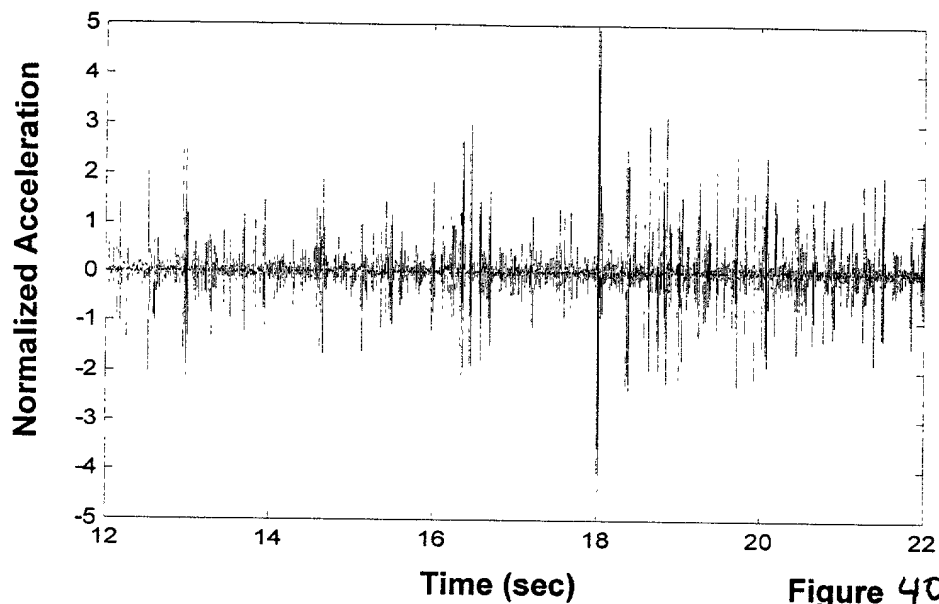


Figure 40

Acceleration Prediction Error (Moderate Bearing Damage)

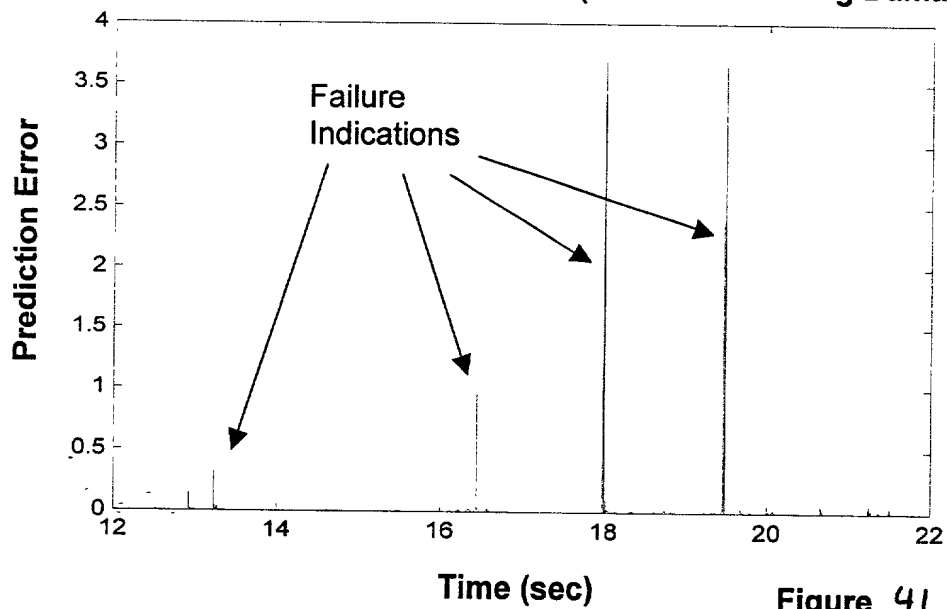


Figure 41

Acceleration (Heavy Bearing Damage)

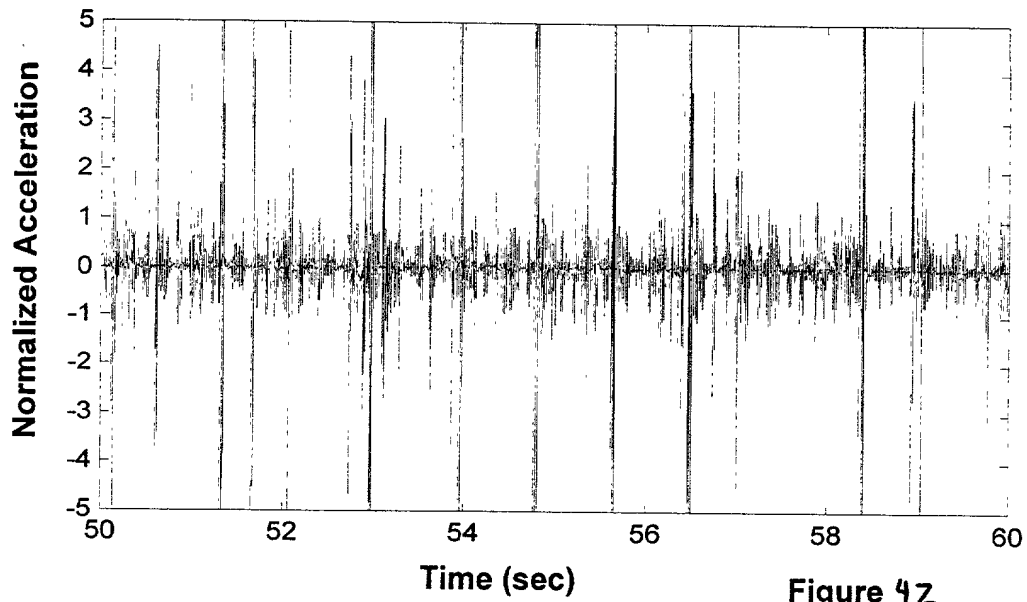


Figure 42

Acceleration Prediction Error (Heavy Bearing Damage)

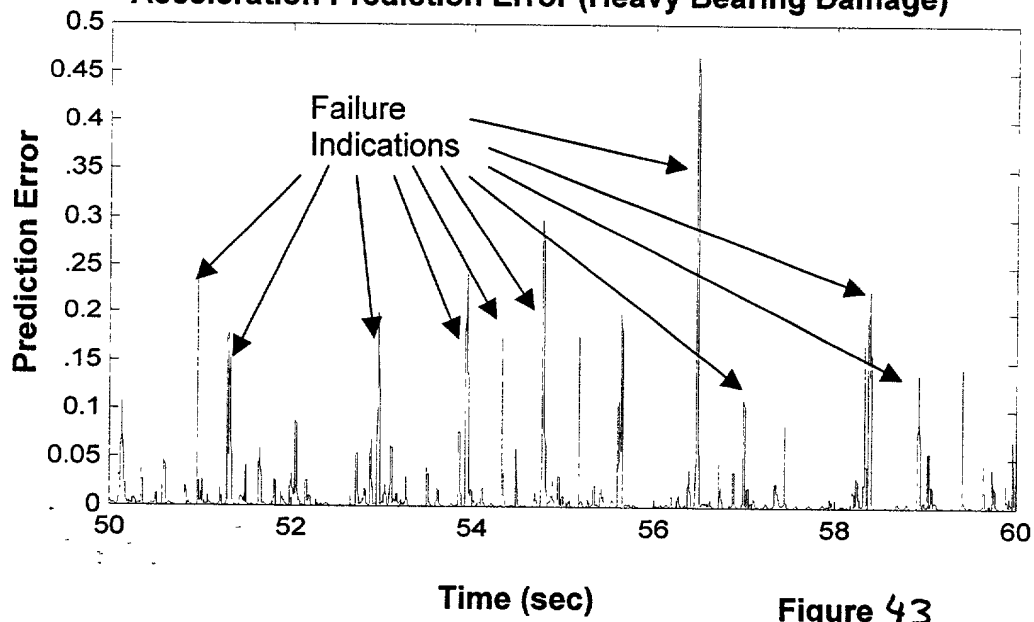


Figure 43

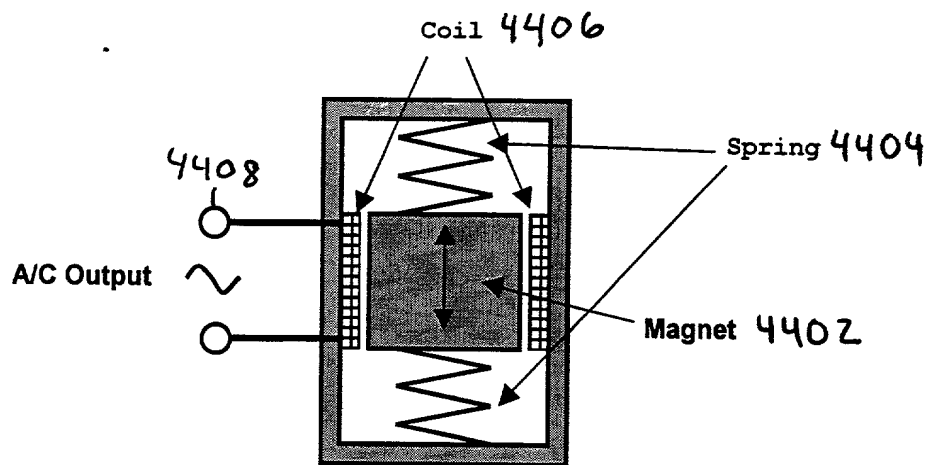


Figure 44 Diagram of Voice Coil Power Generator

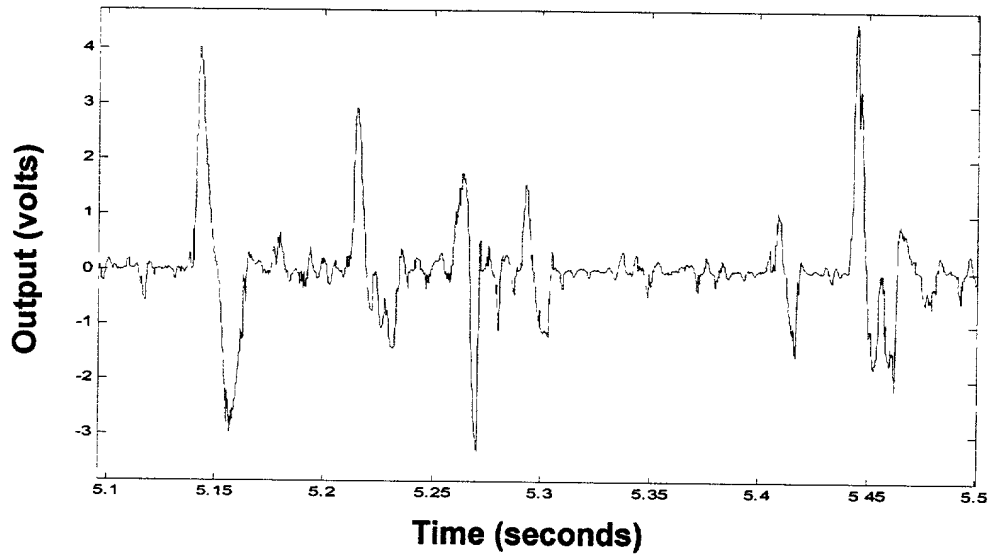


Figure 45 Scaled-Down Prototype Power Generator Output (1000 Ω Load)

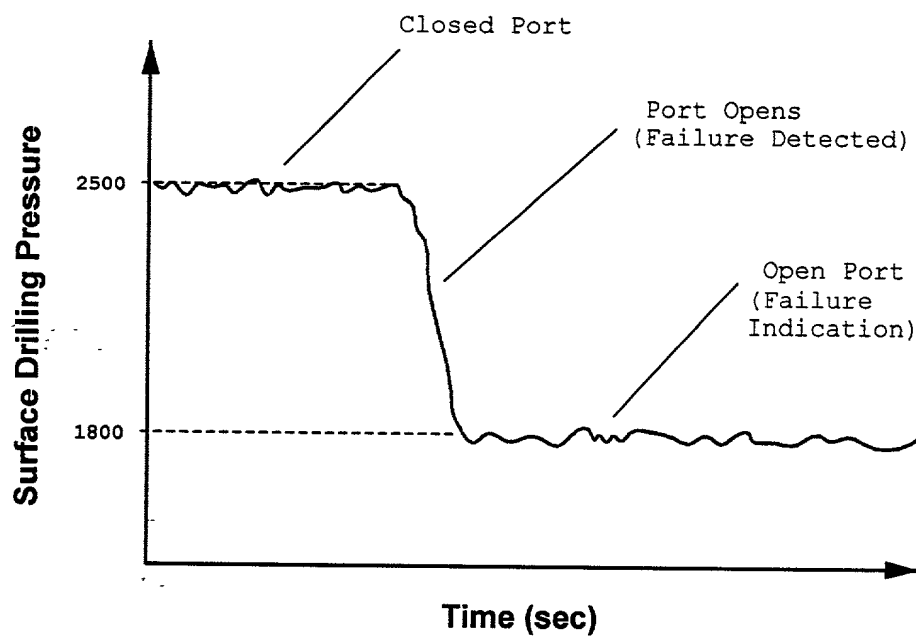


Figure 46 Open Port Failure Indication

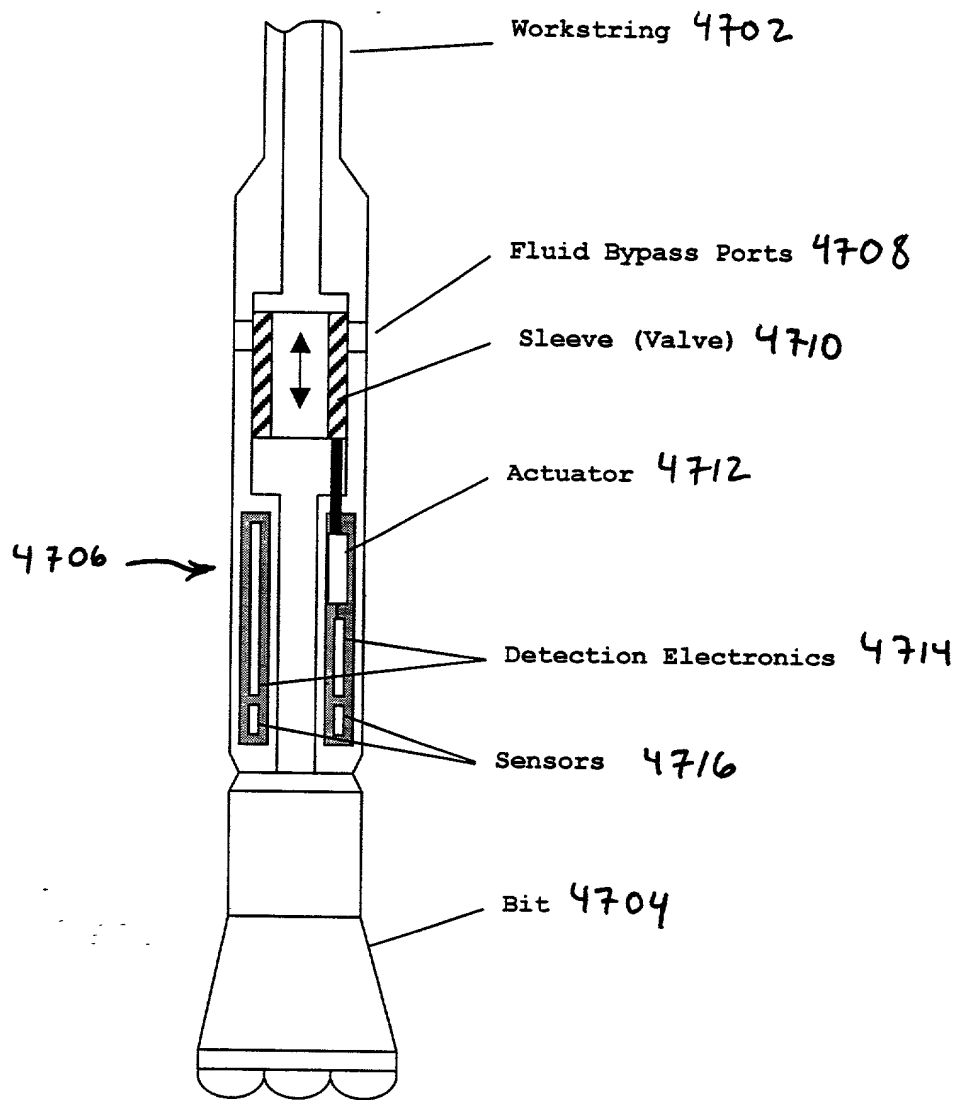


Figure 47 Downhole Tool Schematic

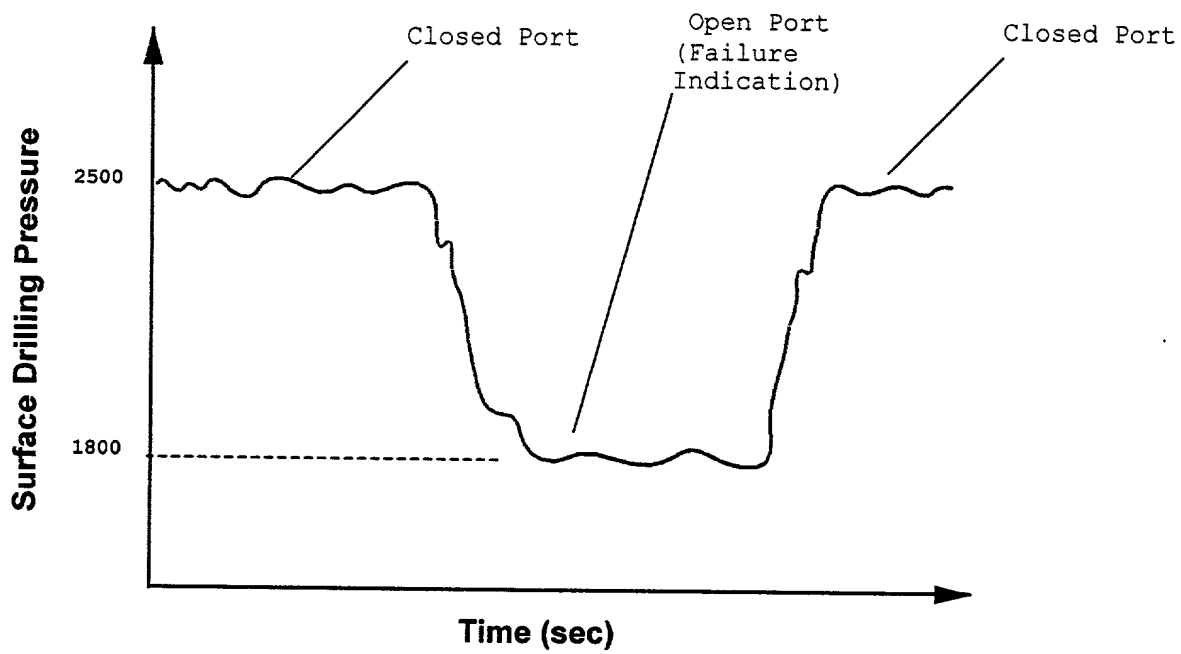


Figure 48 Open-Close Signaling Operation

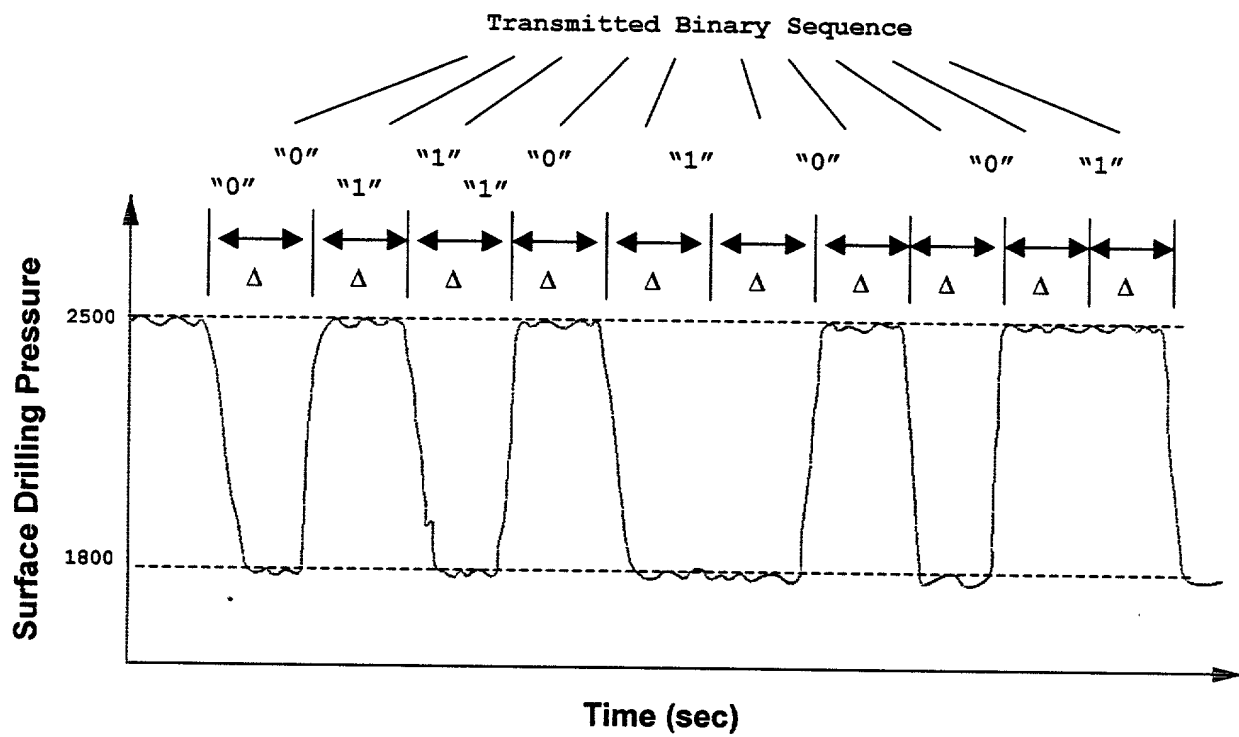


Figure 49 Binary Data Transmission Using Static Pump Pressure Levels

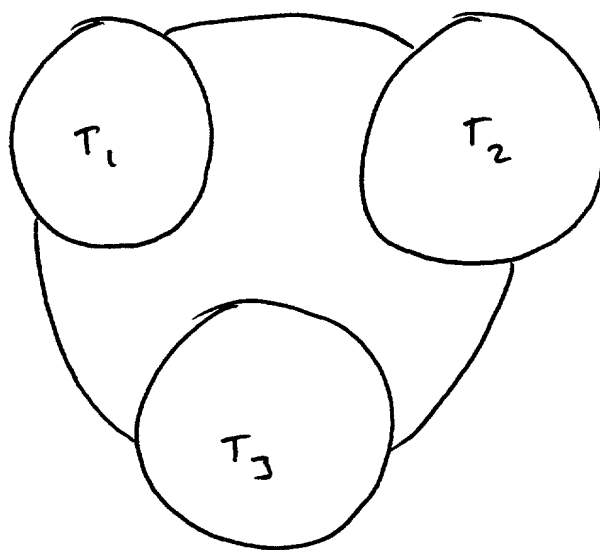


Figure 50

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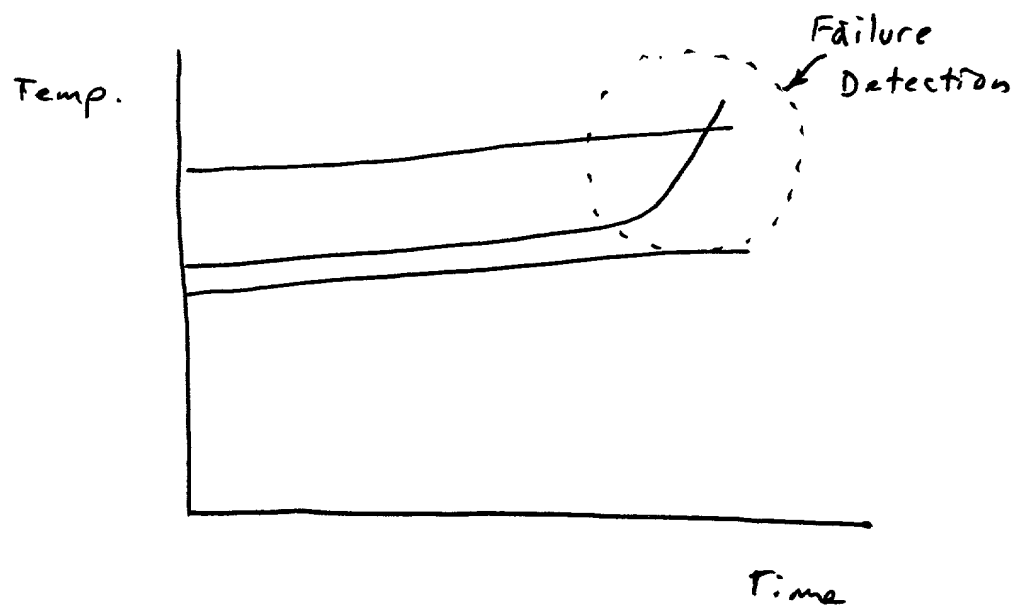


Figure 51

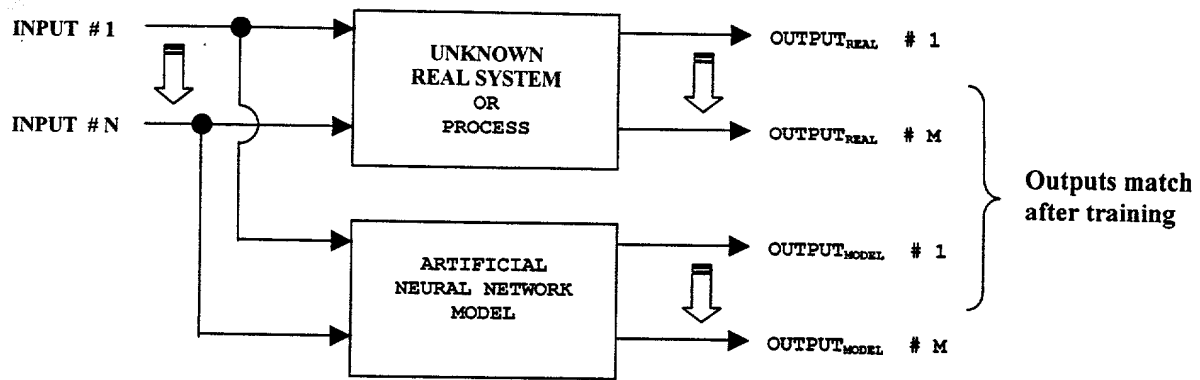


Figure 52 Neural Network Modeling
Real System

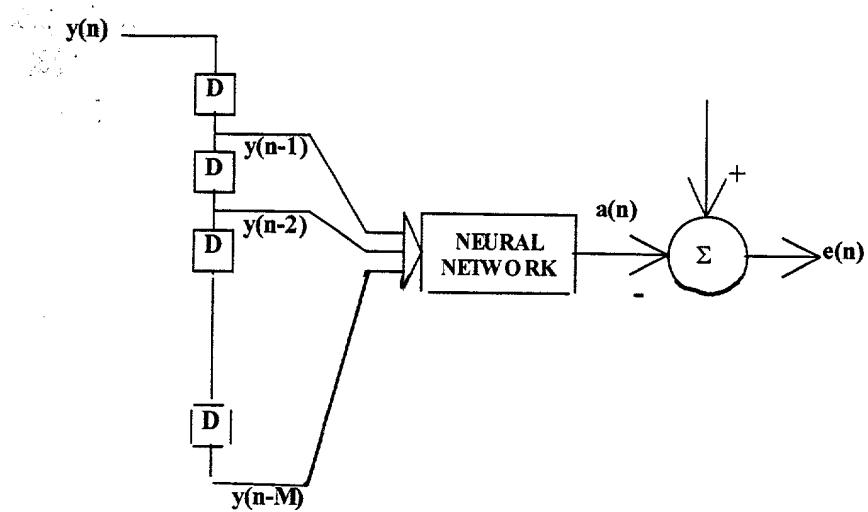


Figure 53

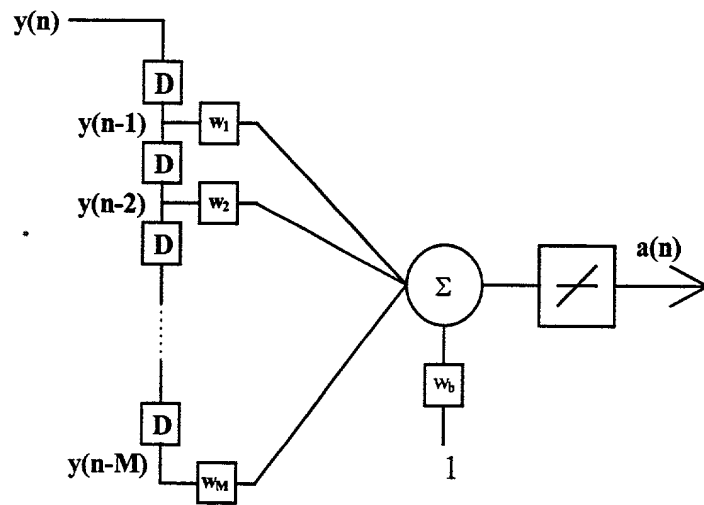


Figure 54 Basic Linear Network

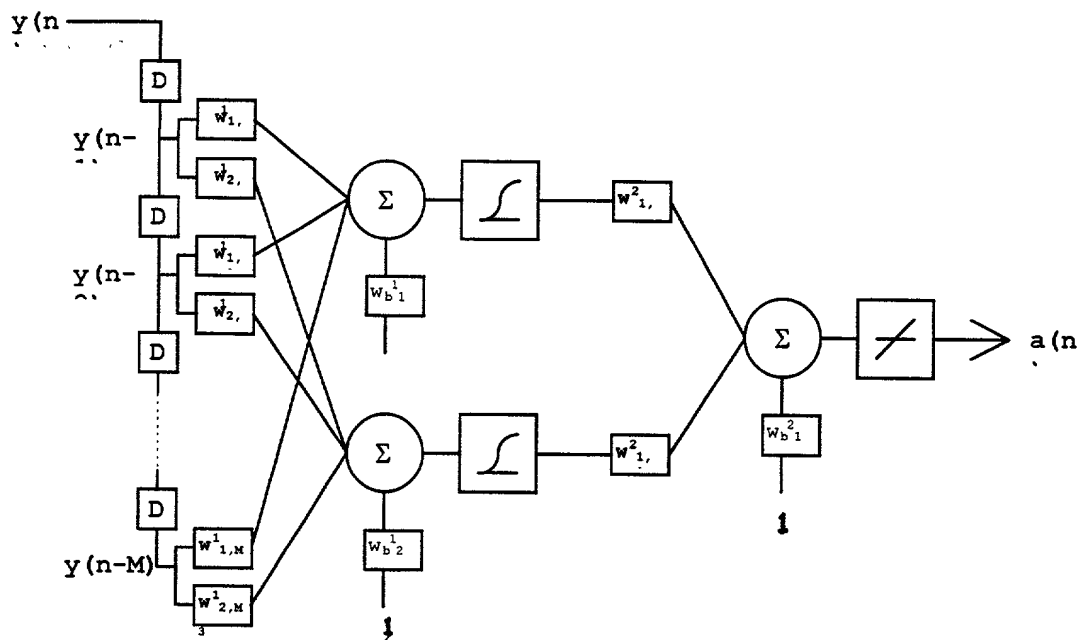


Figure 55

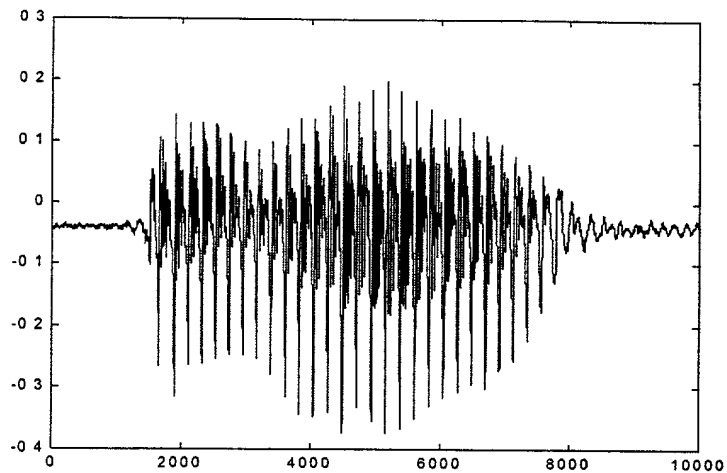
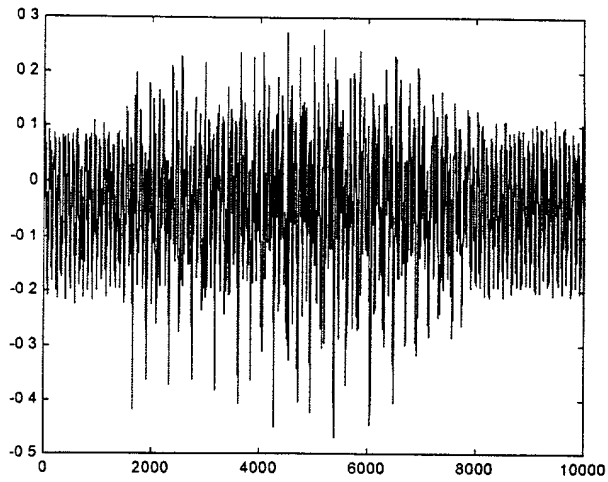
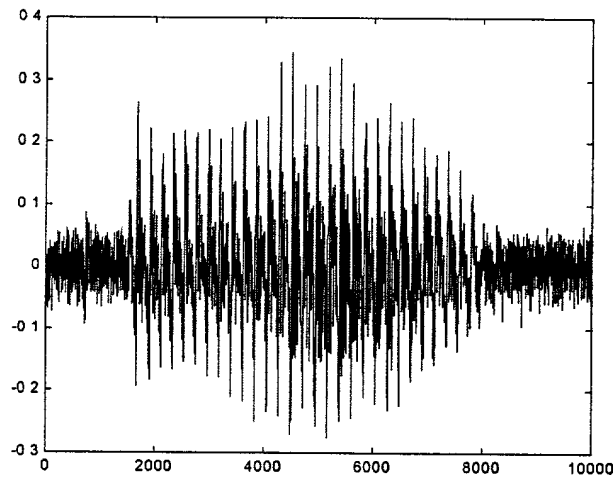


Figure 56

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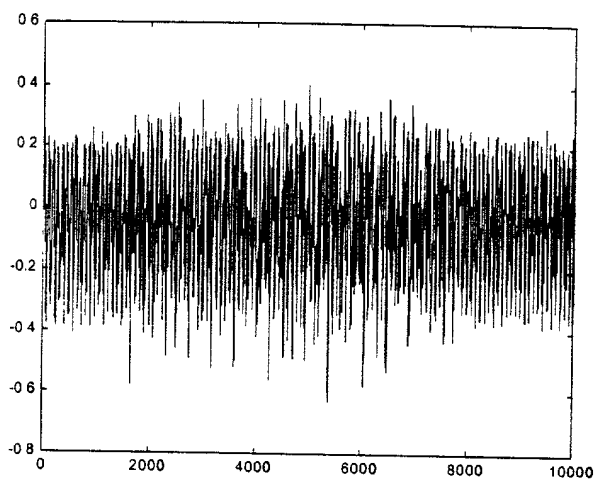


Corrupt Signal S/N Ratio = .95

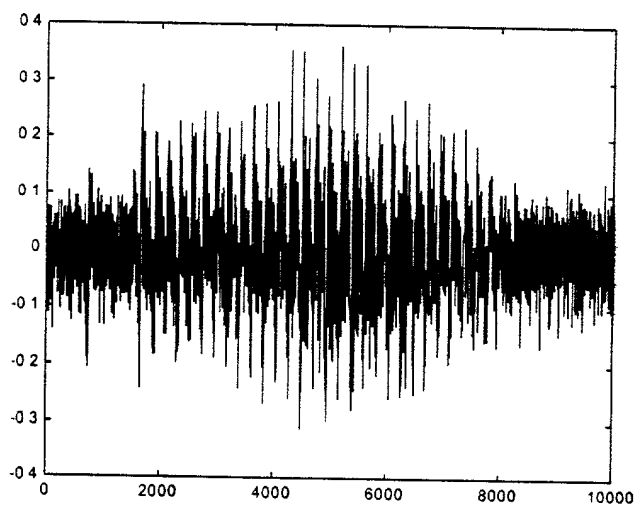


Filtered Signal S/N Ratio = 2.35

Figure 57



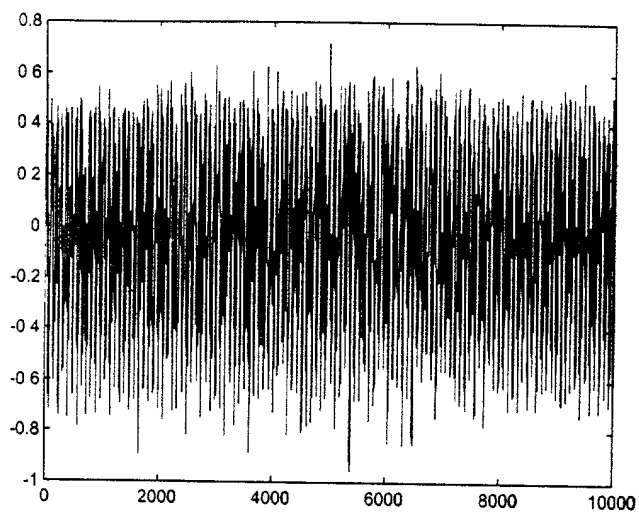
Corrupt Signal S/N Ratio = .24



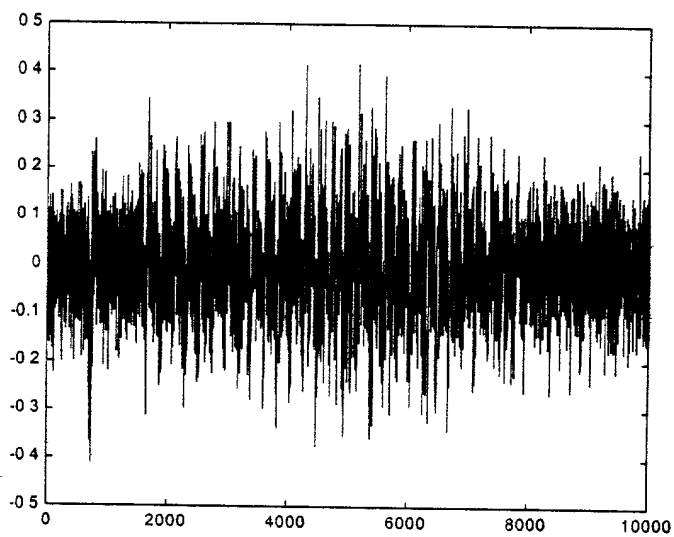
Filtered Signal S/N Ratio = 1.68

Figure 58

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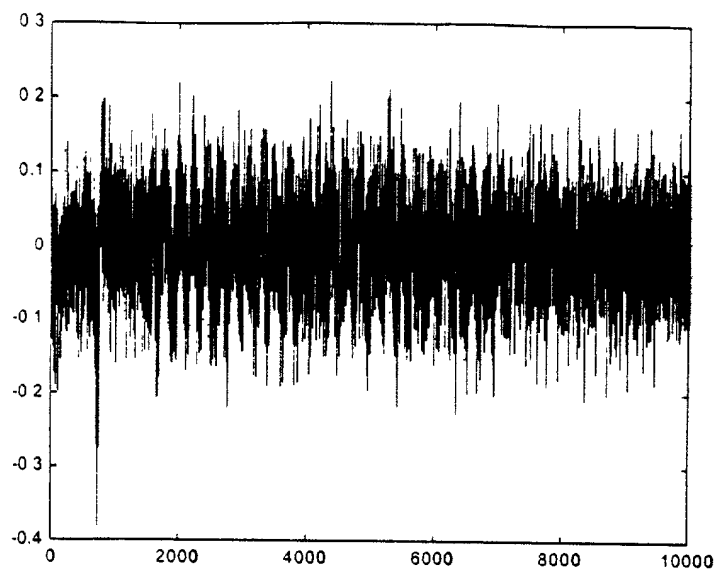


Corrupt Signal S/N Ratio = .06



Filtered Signal S/N Ratio = .89

Figure 59



Linear filter results. $S/N = .7457$

Figure 60